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DISEASES *and* INSECTS
of
GARDEN VEGETABLES

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DISEASES AND INSECTS OF GARDEN VEGETABLES

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GENERAL CONTROL MEASURES

FROM THE TIME the seeds of garden crops are put into the ground until the crops are gathered, diseases and insects must be fought. Vegetable troubles are due to numerous causes, including unfavorable soil conditions—too wet or too dry, too rich or too poor, lack of humus or lime—weather unsuited to some crops, careless use of fertilizers, or attacks of fungi or other parasites. The adoption of the best horticultural practice—crop rotation, the careful application of fertilizers suited to each crop, adequate cultivation, the planting of all crops in their proper season—is important for the successful growing of garden crops. The control of diseases caused by fungi, bacteria, and other enemies requires special additional treatment, as does the damage caused by insects. The purpose of this bulletin is to present briefly control measures for the more important insects and fungous and bacterial diseases of home-garden vegetable crops.²

The use of disease-free seed and plants is fundamental to all disease control. A modified application of the principle of crop rotation can be made even in the home garden by moving the rows of each vegetable to a different place each year. Many diseases and insects live over winter in the soil and will appear on plants again the next season if grown in the same soil. Furthermore, since many of the pests of closely related crops are the same, such vegetables should not be planted in succession. Vine crops should not follow any vine crop, nor should crucifers follow one another.

Numerous important diseases, such as bean anthracnose, pea pod spot, and potato leaf roll and mosaic, are carried in or on the seed and cannot be controlled by seed treatment. It is therefore essential to secure the most disease-free seed obtainable.

Some of the worst garden troubles, such as root knot and clubroot, are brought in on the roots of plants and not only damage the present crop but remain in the soil to attack future crops. In buying plants one should be sure they are healthy and free from insects. The roots should be clean, hairy, and free from knots or swellings. "Prevention is better than cure", especially in the home garden, which usually must be planted on the same ground year after year.

¹ Died Nov. 17, 1933.

² For a more complete discussion of the diseases and insects attacking special crops or for information on the methods of growing garden crops the reader is referred to other publications of the U.S. Department of Agriculture.

Injurious insects may be divided into two classes with reference to their manner of taking in food. Caterpillars, beetles, grasshoppers, and grubs have biting mouth parts and feed by biting off, chewing up, and swallowing the substance of the plant. On the other hand, the mouth parts of plant lice, thrips, leaf hoppers, and plant bugs form a tubular beak through which the juices from within the plant are sucked up and swallowed. On this account, the latter are not affected by stomach poisons that may be applied to the surface of the plant, but must be controlled by contact insecticides or remedies that kill by actually touching the insect.

In growing to maturity insects may pass through two different series of changes. Plant lice, thrips, grasshoppers, leaf hoppers, and plant bugs are hatched from the egg in a form that resembles that of the full-grown insect, usually, however, without wings, although the adult may be winged. On the other hand, newly hatched beetles, moths, and flies first appear in the forms variously known as grubs, caterpillars, and maggots. After passing a variable time in this stage they enter an inactive period, known as the pupa or chrysalis, and in due time cast off their protective covering to become full-grown beetles, moths, and flies. The gardener should become familiar with the different stages of the destructive pests that, taken together, require almost daily repressive measures during the growing season.

In considering the control of the various plant insects and diseases in the following pages the treatment and prevention of each is discussed. Under the heading "Treatment" are discussed the methods of control that may be applied after the disease or insect has appeared in the garden, such as the use of poisoned bait for cutworms, the hand-picking of insects, burning diseased plants, or spraying for disease and insect control. Under "Prevention" are included all measures of control applied prior to disease or insect appearance that will tend to hinder or stop the development of the disease or insect or prevent overwintering and the attack of the next season's crops, such as planting disease-resistant, disease-free, and weevil-free seed, treatment of seed to kill insects and diseases, or the planting of crops on parts of the garden free from these pests.

GENERAL CROP PESTS

While many plant diseases and insects attack only one crop or a group of related plants, there are some that may attack almost any of the garden vegetables. The most important diseases in this class are damping-off and root knot, and the most important insects are cutworms, aphids or plant lice, leaf hoppers, blister beetles, flea beetles, grasshoppers, and wireworms. Red spiders, nematodes, slugs, and snails are also general feeders.

DAMPING-OFF

When seeds of tomato, cabbage, or other vegetables are planted in coldframes or in small boxes in the house to raise early plants for setting in the garden, a disease called damping-off often causes much trouble. Small plants may suddenly fall over and die, or black dead areas may appear on the stems near the soil, which dwarf or kill the plants (fig. 1). This disease usually attacks seedlings that have been overwatered or kept too warm or have not been properly thinned.

Treatment.—Thin the plants where necessary, give them plenty of air and light, and keep the soil fairly dry while the plants are small, watering lightly and only early in the day so the soil will dry off quickly.

Prevention.—The best method of preventing damping-off and root troubles that may attack small plants is to sterilize the soil in the cold-frame or the seed box.³

ROOT KNOT

Southern gardens suffer greatly from eelworms, or nematodes, which cause irregular swellings or galls on the roots of nearly all vegetables. In fact, root knot is perhaps the most widespread and serious truck-crop disease that occurs in the South, causing severe

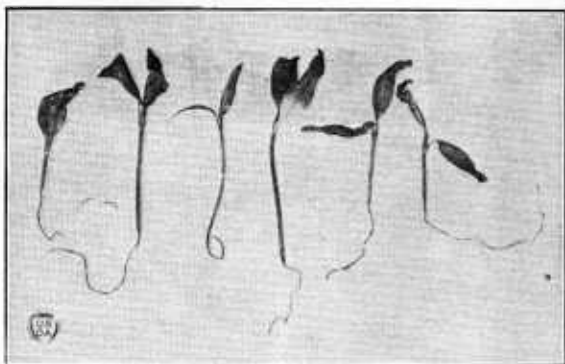


FIGURE 1.—Damping-off of tomato seedlings.

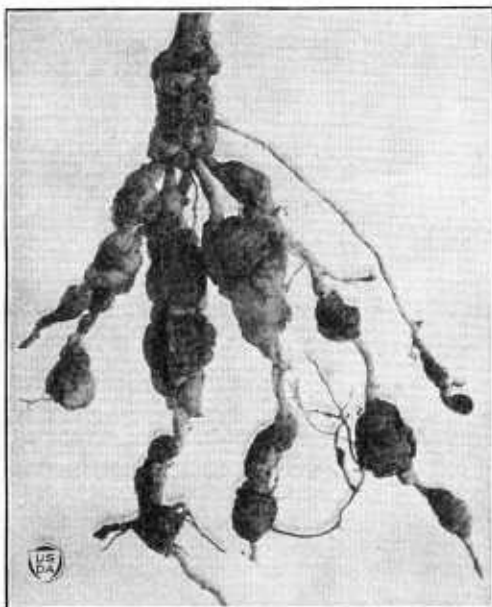


FIGURE 2.—Root knot on tomato. Similar galls occur in infested soil on the roots of many vegetables.

losses due to the stunting and death of many plants and a reduction of yield in others (fig. 2). It is most troublesome in sandy soils. Do not confuse this with the beneficial nodules on beans and other legumes or with the clubroot of the cabbage family.

A garden infested with root knot may produce winter crops, as the eelworms are inactive in cold weather, but for summer crops either a new location must be chosen, in which case every precaution should be taken to prevent root knot from getting a foothold in the garden, or a system of rotation should be started to reduce the nematodes. Rotate the susceptible vegetables with corn or other immune crops.

Have two or three enclosures, if possible, and alternate garden, chicken yard, and immune crops. The fowls will help the immune crops to starve out the nematodes by keeping the place free from all plant growth and will at the

³ Directions for carrying out the different control measures and for preparing the various fungicides referred to in the text are given under the headings Miscellaneous Control Methods and Fungicides, near the end of this bulletin.

same time enrich the ground. Farmers' Bulletin 1345, Root-Knot: Its Cause and Control, gives more complete information on this disease and should be secured⁴ by all who know of its occurrence in their garden or fields.

CUTWORMS

The smooth gray and brown cutworms (fig. 3) hatch from eggs laid in late summer by obscure brownish moths. They reach considerable size before the winter, which they pass as caterpillars, often appearing in great numbers in early spring and summer, hungry from their long fast. Since they feed at night, they may kill many small plants before being observed. They cut off the stems of young plants at the surface of the ground, but certain species climb small plants and cut only the leaves. One cutworm can kill many plants in a night.

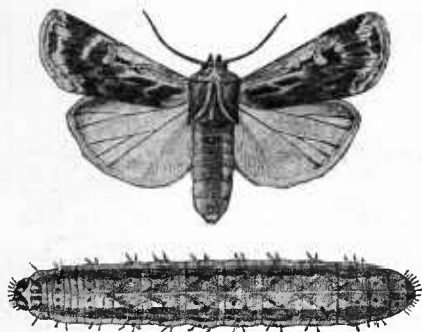


FIGURE 3.—Granulated cutworm: Moth above; cutworm, or larva, below. Somewhat enlarged. (Chittenden.)

Treatment.—The best remedy is poisoned bait. For use in a small garden make this by thoroughly mixing 2 level tablespoonfuls of white arsenic or paris green with 5 pounds of dry bran. Then add from 4 to 6 quarts of water in which a half pint of sorghum or cheap molasses has been mixed. Mix the poison in the morning and apply it late in the day, so that it will be moist and attractive when the cutworms begin to feed in the evening. Scatter it thinly over the garden or about the bases of the plants that have been set out. The treatment should be repeated if necessary. As this mash is poisonous, young children, livestock, and poultry should be kept away from fields where it has been applied.

Hand-picking also is effective in small gardens. The cutworms usually may be found curled up about an inch below the surface of the ground within 3 or 4 inches of the cut plants.

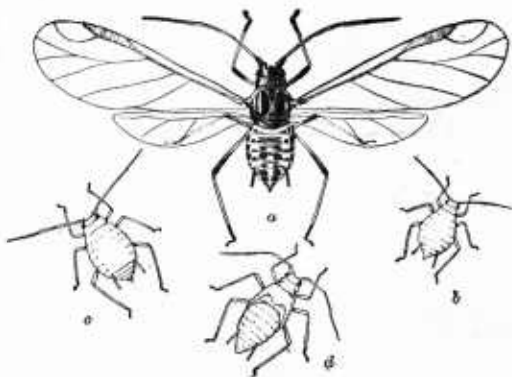


FIGURE 4.—The spinach aphid, showing full-grown aphid and young ones. Greatly enlarged. (Chittenden.)

APHIDS, OR PLANT LICE

Small, soft-bodied insects, known as "aphids" or "plant lice" (fig. 4), usually green but varying to pink, brown, or black, collect on the ends of the twigs or shoots and on the under sides of the leaves of a great variety of plants, where they feed on the sap and often cause

⁴ This bulletin may be obtained for 5 cents a copy from the Superintendent of Documents, Government Printing Office, Washington, D.C.

serious injury by curling the leaves or weakening and killing the young shoots. The young are born alive—often several are produced in a day—and they mature within a few days. Under ordinary conditions practically only females are produced, and the rate of increase is tremendous. Plant lice ordinarily become more injurious during cool, damp weather, being held in check during warm, dry weather by various natural enemies, important among which are ladybird beetles and syrphus flies.

Treatment.—In the treatment of plant lice an ounce of prevention is better than a pound of cure. On their first appearance in the garden it is advisable to apply a spray of nicotine sulphate⁵ or to dust with nicotine dust, either of which treatments should be so applied as to reach the bodies of the insects directly, as contact with the nicotine is necessary for their destruction. Strong soapsuds, fish-oil soap, or other soaps are also useful. If after attack by these pests the application of remedies is neglected, the plants may soon be too far gone to justify treatment.

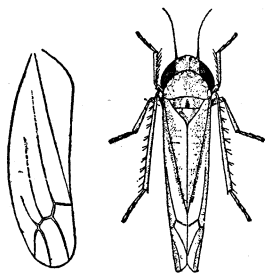


FIGURE 5.—Potato leaf hopper: At right, adult insect; at left, wing extended showing venation. Much enlarged. (Chittenden.)

LEAF HOPPERS

Leaf hoppers (fig. 5) are slender, delicate insects, usually one eighth inch or less in length, and brown to pale green, which have the habit of hopping to considerable distances when disturbed. Among the crops very often attacked are potatoes and beans, the characteristic injury being a whitening and curling of the leaves, with dying of the edges. In the potato this condition is commonly called "hopperburn." The eggs are laid in the leaf tissue or stalks, and two or more broods may be produced annually.

Treatment.—Leaf hoppers live upon the juice of plants and therefore cannot be killed with stomach poisons. Nicotine sulphate or other contact insecticides so applied as to surround the insects when they are leaping or flying from the plants is a most effective remedy.

For the control of leaf hoppers on potatoes and beans bordeaux mixture is satisfactory.

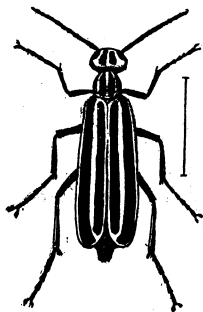


FIGURE 6.—Striped blister beetle: Adult. Enlarged. (Chittenden.)

BLISTER BEETLES

Blister beetles (fig. 6) are common farm pests and are often very destructive to vegetables, especially peas, beans, potatoes, and beets. They travel like army worms, and for this reason are sometimes called army beetles. They are hungry feeders, and often travel in lines, eating everything in their path. They are slender, somewhat soft-bodied, and of various colors, some being entirely black, others brown or yellow with black stripes or spots, and some dark gray or gray spotted with black. The "old-fashioned potato bug", an example of this group, is well known to most gardeners.

⁵ Directions for preparing the different insecticides are given under the heading Insecticides, p. 40.

Treatment.—When the beetles are first seen, dust with sodium fluosilicate diluted with five times its weight of hydrated lime. Arsenical sprays will repel the beetles, although they may not kill them. It is often practicable to knock the beetles into pails or pans containing a small quantity of water upon which a little kerosene has been poured. Hand-picking is also effective, but care should be taken to wear gloves while handling the beetles, as they may blister a tender skin.

See the warning regarding poisonous residues on page 41.

FLEA BEETLES

Flea beetles (fig. 7), as the name implies, are small, dark-colored beetles, which when disturbed jump away in a manner similar to that of a flea. They injure plants by gnawing small holes through the leaves, which often appear as though fine shot had been fired through them. The beetles usually feed from the underside of the leaf. In some cases the substance of the leaf is eaten through only to the upper epidermis. In some localities young seedlings when first sprouting may be seriously damaged by flea beetles. The plants usually attacked are radishes, cabbages, turnips, tomatoes, potatoes, and eggplants.

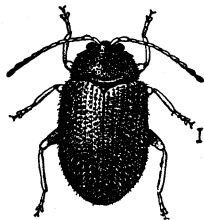


FIGURE 7.—Potato flea beetle: Adult. Actual length shown by line at right. (Chittenden.)

Treatment.—To protect young seedlings nicotine dust may be strewn along the rows or dusted heavily over the plants. Thorough applications of bordeaux mixture, either as a spray or as dust, or of hydrated lime alone, are also effective as repellents.

GRASSHOPPERS

Grasshoppers may prove troublesome in the vegetable garden, the time of attack varying from early spring to late fall. They often strip the leaves of beets and similar plants.

Treatment.—Use the same bran mash as for cutworms, adding one finely chopped orange or lemon to the water before mixing.

WIREWORMS

Wireworms, the slender, hard, brown wormlike larvae of click beetles or "snap bugs," often do great damage to potatoes, carrots, beets, sweetpotatoes, and onions by burrowing through the roots or tubers. The burrows are small in diameter and usually extend directly into the substance of the roots to a depth of from one fourth to one half inch or more. Frequently the worms themselves may be found partially buried in the burrows.

Prevention.—Deep midsummer cultivation and heavy fertilizing will reduce wireworm damage. Under some conditions soil fumigation and flooding are useful.

RED SPIDERS

Nearly all vegetables are attacked by small mites, commonly called red spiders. These mites, so small that they are not readily seen, injure plants by sucking the juices of the leaves, so weakening them that in case of a bad attack the strength and resistance of the plant are sapped and it becomes worthless or eventually dies. In case of a

bad attack great numbers of mites can be found on the undersides of the leaves, and the webs that they spin from plant to plant can be seen with the mites themselves passing rapidly over them and gathering in swarms. The plants often become seriously yellowed or appear as though scorched by fire.

Treatment.—The best-known remedy is to dust with sulphur. Any curling or whitening of the older leaves gives cause to suspect the presence of red spiders. Watch for them and apply the treatment when they first appear, as it is hard to save the plants after they become covered with the webs. Spray with soap and water or with 1 ounce of potassium sulphide in 2 gallons of water. Repeat in a week to catch the young that have hatched out. Where a stream of water from a garden hose is available, a driving forceful spray applied to the undersides of the leaves will often effectively free them of the mites.

SLUGS AND SNAILS

Slugs and snails often do much harm in vegetable gardens, particularly in damp, shady places. They eat large ragged holes in the leaves and may completely destroy young seedling plants grown in hotbeds and cold-frames, leaving a trail of slime wherever they may have crawled. Slugs are soft, slimy animals, black, gray, or brown, and often spotted with black, looking like snails without shells. Some species reach a length of from 5 to 6 inches.

Treatment.—Air-slaked lime scattered about the garden is useful against young slugs. When this comes in contact with the bodies of the slugs they throw off so much slime that they become weakened and die. Spray the plants with bordeaux mixture and distribute the bait recommended for cutworms. The bordeaux mixture will drive the slugs from the plants to the poisoned bait.

Prevention.—To avoid slugs, remove all rotten wood, boards, etc., and keep the entire garden and yard free from all kinds of rubbish in which the slugs may conceal themselves during the day.

PRINCIPAL DISEASES AND INSECTS ATTACKING SPECIFIC GARDEN CROPS

ASPARAGUS

RUST

Asparagus rust is a fungous disease marked by elongated orange or black pustules on the foliage (fig. 8). The tops yellow and die early, and the next year's crop of shoots is reduced.



FIGURE 8.—Asparagus rust.

Treatment.—Rust cannot be satisfactorily controlled by spraying with bordeaux mixture or other fungicides.

Prevention.—Plant Mary or Martha Washington asparagus, strains that have been bred by the Bureau of Plant Industry for rust resistance, vigor, yield, and quality. These strains are now available from many seedsmen. Other semirust-resistant varieties are Reading Giant, Argenteuil, and Palmetto.

ASPARAGUS BEETLES

The common asparagus beetle (fig. 9) is about one fourth inch in length and colored red, black, and yellow. The larvae or grubs, as well as the beetles, feed on the foliage of full-grown asparagus and at times gnaw and disfigure shoots of cutting size. The larvae are grayish and similar in size to the beetles.

Treatment.—Cut shoots early and often to prevent eggs from hatching on them. Leave occasional shoots to mature and attract

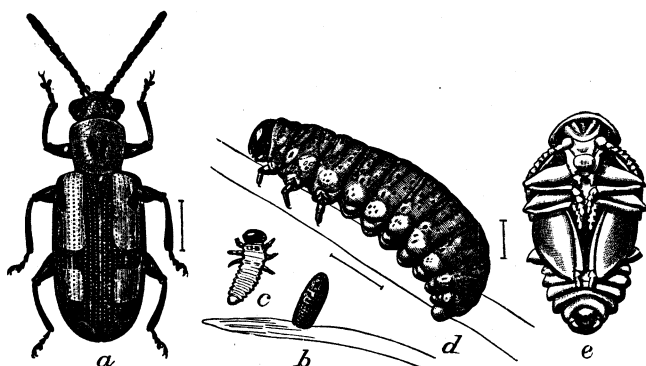


FIGURE 9.—The common asparagus beetle: a, Beetle; b, egg; c, newly hatched larva; d, full-grown larva; e, pupa. All enlarged. (Chittenden.)

the adults for egg laying, and spray these thoroughly with an arsenical. *Shoots intended for eating should not be poisoned.* Asparagus beetles attacking full-grown asparagus should be controlled by being sprayed from both sides, and the next brood thus reduced.

BEANS

ANTHRACNOSE, OR POD SPOT

Most gardeners recognize anthracnose or pod spot by the roundish sunken spots with dark-brown or black borders and pink centers that it causes on the young pods (fig. 10). It also produces elongated, sunken, dark-red cankers on the stems and leaf veins and grows through the pods and causes rusty-looking spots on the ripe seed (fig. 10). The causal fungus lives over winter in the seeds and attacks the young seedlings. Pod spot is most serious in moist, cool seasons and often does not occur in dry, hot summers.

Treatment.—Pull and burn the first plants showing the disease. Anthracnose is spread by wind and rain, also by insects and on the hands of pickers. Hence avoid cultivating or walking through the beans or picking them while the plants are wet with rain or dew.

Prevention.—No seed treatment has been found successful, as the fungus is under the seed coat, where fungicides cannot reach it without also killing or injuring the seed. Rotate crops so that beans will not be planted on the same land oftener than once every third or fourth year. Save seed for planting from perfectly healthy pods that show no spots, or secure seed having the least possible amount of spotting and discard any showing the slightest discoloration. Wherever possible, seed grown in Colorado or other far-Western States that are free from anthracnose should be used. The anthracnose-resistant varieties, Well's Red Kidney, Western Red Kidney, White Imperial, and Perry Marrow, all belong to the dry shell-bean type.

BLIGHT

Bean blight, a bacterial disease, causes irregular diseased areas on the leaves, which at first are water-soaked, later become brown and brittle, and usually have pale-yellow borders (fig. 11). It attacks the stems, producing reddish cankers and sometimes becoming systemic. The stems are often girdled, and the plants then break over during storms. On the pods, slightly raised watery pustules appear which later enlarge and become irregular in shape and rusty in color (fig. 11). The disease is carried in the seed, which often becomes yellow and shriveled or shows yellow, diseased blotches.

Treatment and prevention.—The same as for anthracnose.

A few varieties of garden bush beans are fairly resistant to the disease: Late Stringless Green Refugee, Refugee 1000-1, and Refugee Wax. The use of clean seed, when available, is most important. Seed produced in certain Western States—Idaho and California, for example—is largely free from this disease and should produce a crop relatively free from blight.

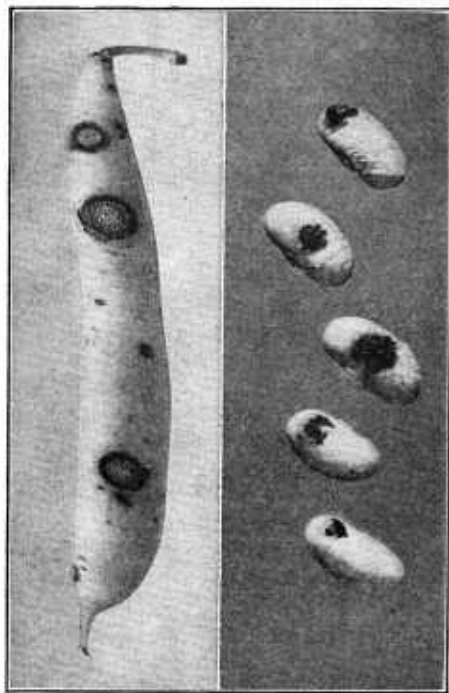


FIGURE 10.—Bean anthracnose on pod and seeds.

MOSAIC

Bean mosaic is marked by the mottling of the leaves into light- and dark-green areas, accompanied by the curling and stunting of the foliage (fig. 12) and by reduction of yield. The disease is carried in the seed from diseased plants and, once introduced, is spread by plant lice.

Treatment.—Prompt destruction of the first mosaic-affected plants seen and the control of plant lice will help to reduce the rapid spread of mosaic.

Prevention.—Avoid mosaic by planting disease-free seed saved from healthy plants where possible. When available use mosaic-

resistant seed where mosaic is very prevalent. The following is a partial list of dwarf garden beans fairly resistant to mosaic: Green-pod variety—Bountiful; wax-pod varieties—Davis White Wax, Improved Kidney Wax, Wax, and Unrivalled Wax; pole varieties—Kentucky Wonder and Kentucky Wonder Wax.



FIGURE 11.—Bean blight on leaf and pod.

RUST

The true rust, here referred to, is caused by a fungus closely related to that responsible for the common grain rust. It appears on the leaves, stems, and pods as tiny red pustules, which later become black, and causes the leaves to turn yellow and fall to the ground. The disease is carried in or on the seed.

Prevention.—Where rust is a limiting factor resistant varieties are available for planting. Of dwarf green-pod snap beans, the following are fairly resistant: Bountiful, Full-Measure, Late Stringless Green Refugee, and Extra Early Refugee. Fairly resistant wax-podded varieties are Improved Golden Wax and Sure Crop Wax. Among pole beans, Lazy Wife is a fairly resistant variety.

WEEVILS

The worst insect enemies of beans are weevils. Attack begins in the field from eggs laid on the pod. The eggs hatch into larvae, or grubs, which at once burrow through the pod into the beans, completing their growth inside. Soon after the beans are harvested the grubs change to weevils and begin to come out. A second brood of the common bean weevil may be enough to ruin a crop of beans for either human food or seed. Several broods may be produced in a year. The common bean weevil (fig. 13) is dull gray with reddish legs and is about one eighth of an inch long.

Treatment.—Bean weevils cannot be controlled in the field. They breed in dry seed, and it is therefore best to harvest the crop and as soon as it is dry to fumigate it with carbon disulphide. *Carbon disulphide gives off a gas that is very explosive if brought into contact with fire.*

Prevention.—Plant only seed free from weevils.

BEAN LEAF BEETLE

The bean leaf beetle (fig. 14) does much injury in the Eastern States and from Ohio southward to Louisiana. The beetles eat large round



FIGURE 12.—Mosaic disease on bean leaves.

holes in the growing leaves, usually working from beneath. They also feed on such wild plants as beggarweed or tickseed. The grubs

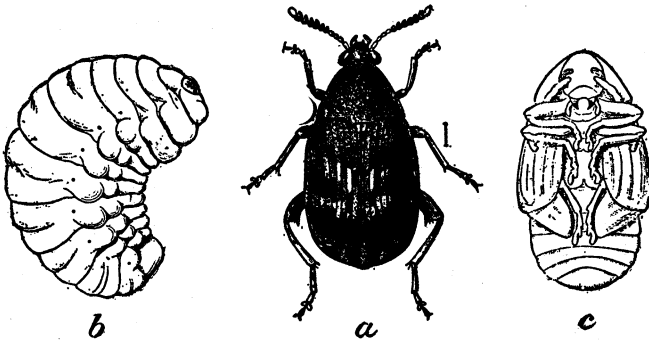


FIGURE 13.—The common bean weevil: *a*, Full-grown beetle; *b*, grub; *c*, pupa. Greatly enlarged. The small straight line between *a* and *c* shows the length of the full-grown weevil. (Chittenden.)

feed on the roots and main stems just below the ground, their habits being much the same as those of the better-known cucumber beetles.

Treatment.—Apply the remedies recommended for the Mexican bean beetle, as soon as the injury is noticed.

MEXICAN BEAN BEETLE

The Mexican bean beetle is a yellow or brownish lady beetle, spotted with 16 black marks, as shown in figure 15. It has long been present in the Rocky Mountain region and is now generally distributed in the Eastern States. It destroys table beans of all kinds and feeds also on cowpeas, soybeans, and some related crops. The

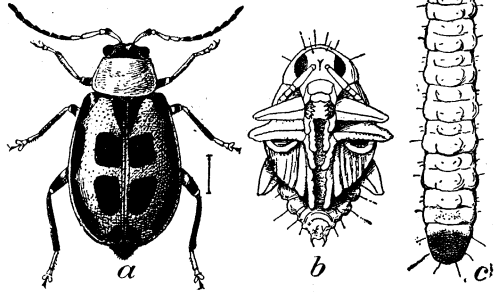


FIGURE 14.—The bean leaf beetle: *a*, Full-grown beetle; *b*, pupa; *c*, grub. Greatly enlarged. The small straight line between *a* and *b* shows the length of a full-grown beetle. (Chittenden.)

spiny yellow larvae, or grubs, feed on the undersides of the leaves and completely strip the plant within 1 or 2 weeks.

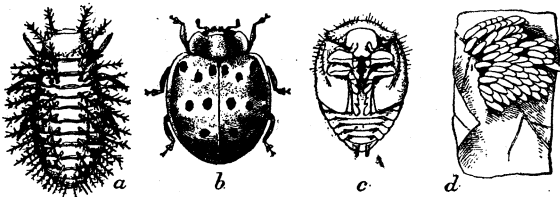


FIGURE 15.—The Mexican bean beetle: *a*, Larva; *b*, beetle; *c*, pupa; *d*, egg mass. About three times natural size.

Treatment.—Bean foliage is easily injured by the usual arsenicals, so magnesium arsenate, 1 ounce to 3 gallons of water, sprayed on

the undersides of the leaves is the best remedy. Do not spray snap beans with an arsenical after the pods have started to form. When the crop is in the bearing state pyrethrum extracts or fresh pyrethrum powder are satisfactory for small plantings if applied so as to actually touch the insects.

BEAN APHID

The bean aphid is a very small, blackish plant louse that does damage in all parts of the United States.

Treatment.—(See aphids, or plant lice, p. 4.)

BEETS AND CHARD

LEAF SPOT

In leaf spot numerous small round to irregular dead spots with white centers and purple borders appear on the leaves (fig. 16). They are caused by a fungus that attacks both beets and chard, often causing the leaves to curl, dry up, and die.

Treatment.—For beets, spray with 4-4-50 bordeaux mixture when the

first spots are noted and repeat at 10-day intervals. For chard, pick off and burn the badly spotted leaves and stimulate new growth by liberal applications of nitrate of soda.

Prevention.—Crop rotation.

BEET FLEA BEETLE

The beet flea beetle (fig. 17), also called the spinach flea beetle, is very injurious to table beets, attacking them as soon as they are above the ground. The young, or larvae, grow on chickweed and pigweed, and a second brood attacks the beets. The young sometimes become so abundant as to destroy entire rows of beets before the insects are even seen by the gardener. They even work down and bore into the crowns of the plants.

Treatment.—This insect can be kept down readily by spraying with paris green when the pest is first seen, and again as often as needed. *Do not use for greens foliage treated with a poison.*



FIGURE 16.—Beet leaf, showing leaf spot.

Prevention.—Chickweed, pigweed, and lambsquarters are the natural food plants of the flea beetle, and these should be killed in the early spring. Cutworms also feed on these weeds.

BEET WEBWORMS

Several kinds of webworms attack beets by eating the leaves, which become webbed together on the growing plant. The worst of these pests, known as the beet webworm, is shown in figure 18.

Treatment.—Spray with paris green.

Prevention.—The garden should be kept free from weeds such as pigweed, which will encourage webworms and help them to spread. See warning regarding poisonous residues on page 41.

CABBAGE

Many of the diseases that attack cabbage also cause damage to other crops of the same family, including cauliflower, turnips, brussels sprouts, and collards, as well as some related wild plants.

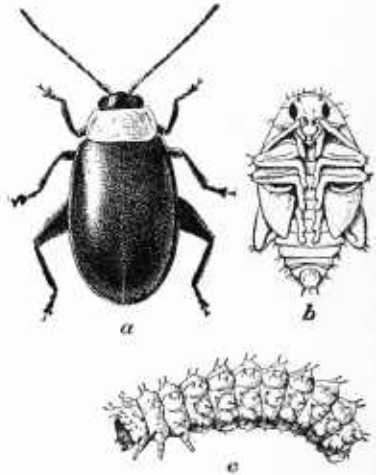


FIGURE 17.—The beet flea beetle: a, Beetle; b, pupa; c, full-grown grub. Greatly enlarged. (Chittenden.)

CLUBROOT

Clubroot, also called fingers-and-tocs, is caused by a minute slime mold which enters the roots and produces large irregular swellings and malformations like those shown in figure 19. Diseased plants are stunted, have a sickly yellow appearance, often wilt during the heat of the day, and generally fail to head. The trouble may attack the plants in the seed bed, or after they are set out.

Treatment.—There is no remedy for plants once attacked by clubroot.

Prevention.—Rotate crops so that no crop of the cabbage family is planted on land where clubroot has occurred for several years previously, and do not allow weeds of the same family, such as mustard and shepherds-purse, to grow there. If no clubroot-free land is available, apply lime, preferably hydrated, at the rate of 25 pounds per square rod,

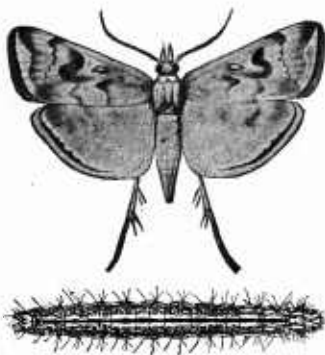


FIGURE 18.—Beet webworm: Above, moth; below, full-grown larva. Enlarged. (Chittenden.)

working it deeply into the soil several months before planting.

Take special care that only healthy seedlings are planted. If plants are home-grown, sterilize the soil in which seed is to be planted. Burn diseased plants. Do not put them on manure or compost piles.

YELLOWS, OR WILT

Cabbage plants attacked by yellows are stunted, turn a lifeless yellowish green, and the lower leaves fall off. Often one-sided plants are found (fig. 20). The disease is caused by a fungus that lives in the soil and grows into the roots and up the water vessels, causing a dark-brown ring in the stem. Often the worst diseased plants wilt, curl up, and die soon after being transplanted. Many live a month or more or through the season, but few produce heads. In many locali-



FIGURE 19.—Cabbage plant with large knotted roots caused by clubroot.



FIGURE 20.—Cabbage plant stunted and leaves curled by yellows.

ties wilt is the most important cabbage disease and causes heavy losses in gardens and fields.

Treatment.—There is no treatment for diseased plants. It is a waste of time to set out plants having the disease.

Prevention.—Plant on uninfested soil if available, being sure that only healthy seedlings are used. If plants are home-grown, sow seed only in disease-free or sterilized soil. Practice crop rotation. If the entire garden is infested with yellows, secure seed of yellows-resistant varieties, several of which are now available and are being handled by a number of seedsmen. The yellows-resistant Wisconsin Hollander is a late storage cabbage that has been developed from Hollander or Danish Ballhead, while Wisconsin All Seasons and

Wisconsin Brunswick are flat types, somewhat earlier and specially adapted for making sauerkraut. Resistant midseason strains, Marion Market, Globe, All Head Select, and an early strain, Jersey Queen, are now available from a few seedsmen.

BLACK ROT

Cabbage plants attacked by black rot usually have yellowed leaves with areas on the edges showing blackened veins (fig. 21), and the inside of the stems exhibits a black ring. Plants may be attacked by black rot at any time during their growth. Affected plants may die

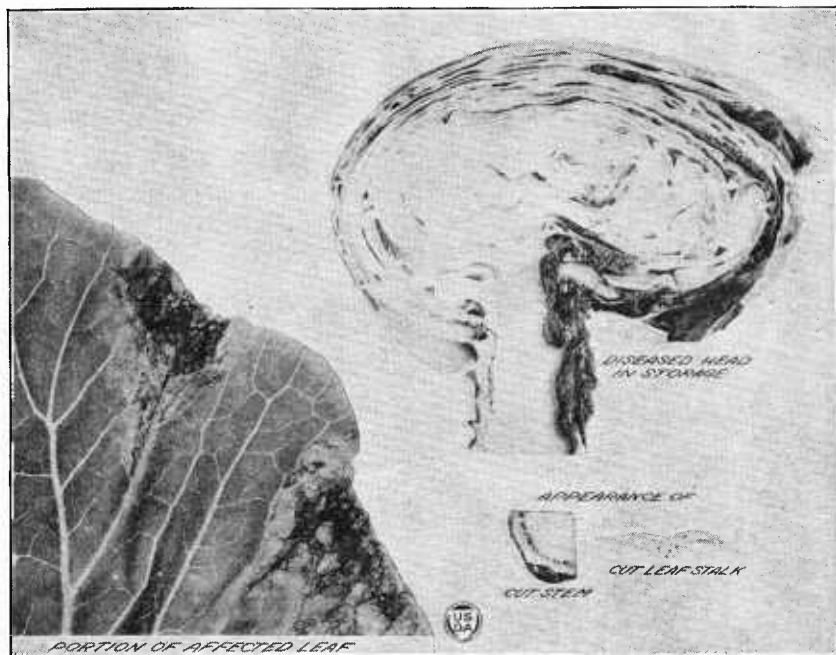


FIGURE 21.—Cabbage black rot.

early in extreme cases or fail to form heads. Diseased heads often rot in the field or in storage (fig. 21). Serious losses often result.

Treatment.—There is no treatment that will stop the disease when once started. Pulling and burning affected plants as soon as the disease is noted helps to prevent the spread of the trouble.

Prevention.—A long crop rotation in which neither cabbage nor related plants are allowed to grow on infested land is very important. Disinfect the seed in mercuric-chloride solution before planting (p. 40), or treat for 30 minutes in hot water at 122° F. A higher temperature may kill the seed. Plant in seed-bed soil known to be free from black rot, or in disinfected soil.

BLACKLEG

Blackleg may attack cabbage plants while they are very small, often in the seed bed. It is caused by a fungus which produces a

blackening and rotting of the stem and on the leaves dark spots in which tiny black pimples appear (fig. 22). The leaves often turn purple, and later the whole plant wilts so the tips of the leaves rest on the ground. The disease is carried on the seed and is often spread from diseased to healthy plants in the seed bed by water spattered on the foliage during sprinkling or during rainstorms.

Treatment.—Pull and burn diseased plants as soon as found in the seed beds. Avoid the spread of the disease by being careful in

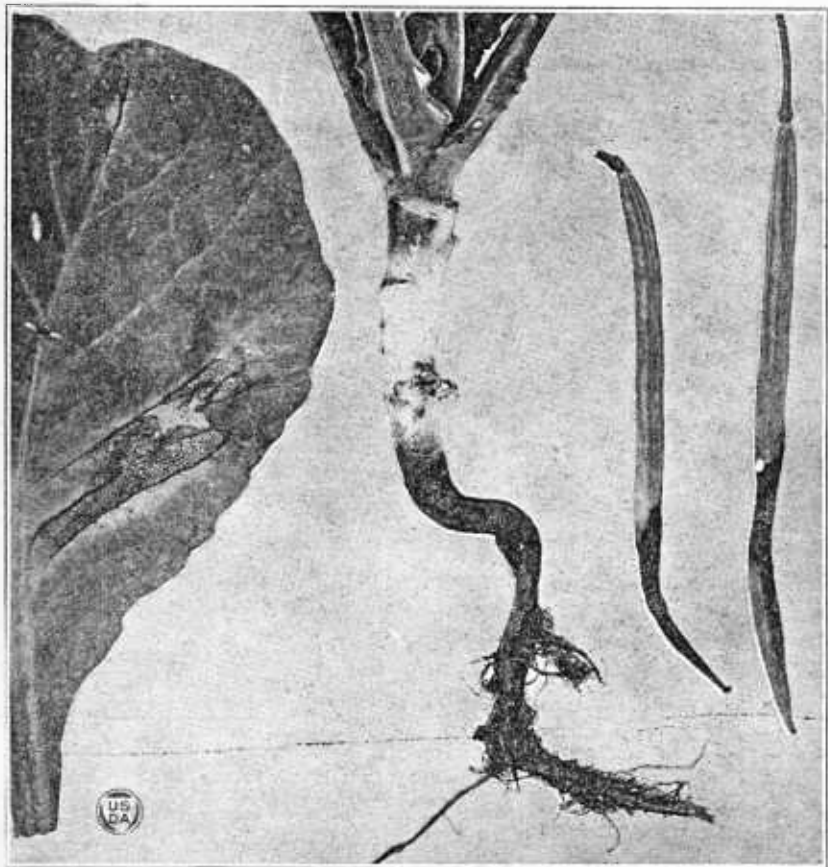


FIGURE 22.—Blackleg of cabbage, showing injury and blackening of the main root and diseased spots on the leaf and seed pods, in which numerous black fruiting bodies of the causal organism are evident.

watering to avoid wetting the foliage and by protecting the seed bed from rain.

Prevention.—Follow the preventive measures suggested for black rot.

COMMON CABBAGE WORM

Many gardeners do not know that the white butterfly (fig. 23) so common in the vicinity of cabbage plants is the parent of the velvety green caterpillar, so commonly injurious to cabbage. The butterfly lays the eggs from which come a brood of caterpillars. These begin work early in the season. After eating the outer leaves they attack

the tender inner leaves as they form, hiding in the young heads, where it is hard to reach them with a spray. In cool weather the caterpillars often feed on the upper surface of the leaves, and at such times they are easily killed. The butterflies occur from March to October, and the worms are at work from April to September and later.

The cabbage worm also feeds on cauliflower, kale, collards, turnips, radish, and horseradish.

Treatment.—Rotenone dusts, such as those produced from derris or cubé roots, have given the best control. Satisfactory results have been obtained by using 10 to 15 pounds per acre of dust containing from 1 to 2 percent of rotenone. Pyrethrum dusts and extracts are also effective. As these dusts and extracts vary in strength they should be used according to the directions of the manufacturer.

Prevention.—The clearing up and burning of all such weeds as mustard, shepherds-purse, and peppergrass before setting out cabbage plants will help to keep down the number of worms. Destroy all injured plants, remnants, and stalks by burning as soon as the main crop is harvested.

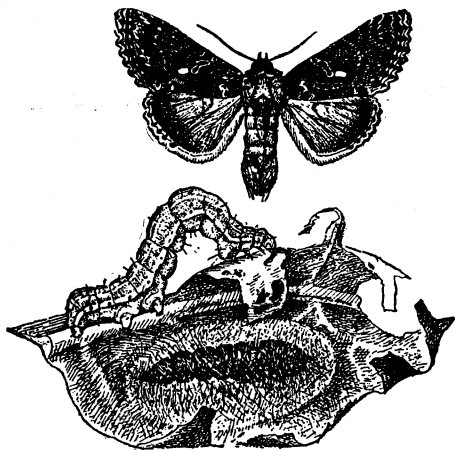


FIGURE 24.—The cabbage looper: Above, moth; below, young looper and chrysalis. Enlarged. (Chittenden.)

Treatment and prevention.—Same as for the common cabbage worm.

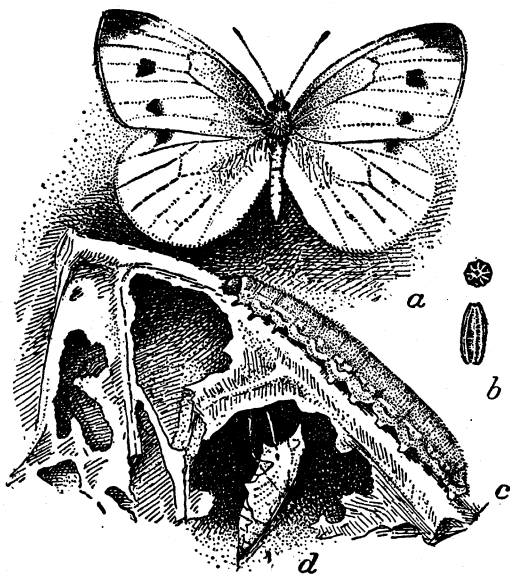


FIGURE 23.—The common cabbage worm: Above, butterfly; below, cabbage worm (c) and chrysalis (d); greatly enlarged egg (b). (Chittenden.)

CABBAGE LOOPER

The cabbage looper (fig. 24) is the young or worm stage of a medium-sized gray moth. It is pale green and delicate-looking when first hatched. When larger, it becomes striped and gets its name of looper by its habit of doubling up, or looping, as it crawls. It eats all kinds of cabbage-like plants, and sometimes peas, beets, celery, and lettuce.

HARLEQUIN BUG

The harlequin bug, also called the calico bug, fire bug, or terrapin bug, is about half an inch long and red, spotted with black. It is a southern insect, commonly found from Virginia to California, but it often works northward.

Treatment.—Derris extract, 4 tablespoonfuls to 3 gallons of water, with two 1-inch cubes of soap added, has been found to have some value against the young bugs, but the full-grown ones are almost spray-proof. Hand-pick the full-grown bugs and eggs early in the season. The eggs look like small black-banded barrels on end and are placed in clusters on the undersides of the leaves.

Prevention.—Clean culture, especially in the fall, and planting trap crops of mustard or other plants of the cabbage family in the spring will help to prevent damage by this insect.

PLANT LICE

Plant lice of three kinds, the cabbage aphid, turnip aphid, and spinach aphid, do much damage to cabbage. These insects are very

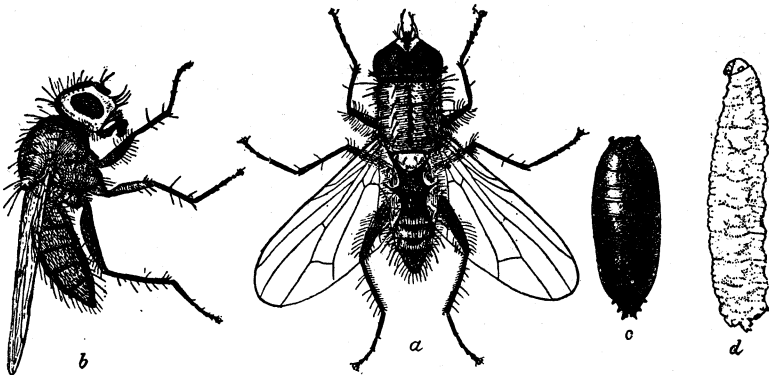


FIGURE 25.—A typical root maggot: a, Back view of fly; b, side view; c, puparium; d, maggot. Greatly enlarged. (Chittenden.)

small, soft-bodied, and greenish or yellowish. They appear early in the spring and sometimes remain as late as December.

Treatment.—The best remedy is nicotine sulphate. Pyrethrum extracts and soap are also good. Washing down the plants with a strong stream of water from a syringe, garden hose, or a sprayer will often keep this pest from killing them. Treatment should be given the plants when the pests are first seen.

Prevention.—Keep the garden free from the weeds on which plant lice feed.

CABBAGE MAGGOT

Cabbage and related crops often suffer badly from the attacks of the cabbage maggot, the young of a small fly which resembles the ordinary house fly (fig. 25). The eggs are laid around the roots of young plants when they are first set out; and the newly hatched maggots, by gnawing off the outer surfaces of the stems and boring into the larger roots and lower part of the stalks, seriously injure the

young plants. When very common, the cabbage maggot is one of the hardest pests to control.

Treatment.—Bichloride of mercury, when used as recommended, will not poison plants or render them unfit for consumption. To prepare the solution for use against the cabbage maggot, dissolve one half ounce of corrosive sublimate in a pint of hot water in a glass or earthenware vessel. Dilute to 5 gallons, which will be sufficient to treat from 200 to 300 plants. Apply soon after the cabbage plants are set out and again about 12 days later, pouring half a teacupful of the solution over the soil at the base of each plant.

The cabbage maggot frequently attacks radishes, rutabagas, and turnips, which may be protected by applying mercuric chloride solution directly to the rows by means of a watering pot or similar vessel.

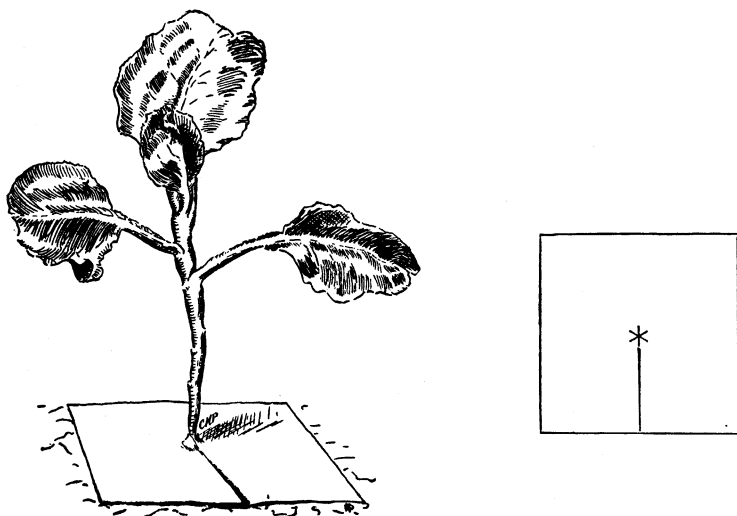


FIGURE 26.—Sketches showing how tarred-paper pads are made and used to keep root maggots from cabbage plants.

Another means of combating this pest in small gardens is to use squares or disks of tarred paper to protect the plants against the egg laying of the fly (fig. 26). To make the protectors, cut 3-inch squares of tarred building paper and make a slit from one side to the center and several short slits like a star at the center, as shown in the illustration. Place the square around the plant just before it is set out and press the paper closely around the stem and down against the ground. The squares must fit tight to keep out the fly.

Prevention.—Destroy all old plants by burning in the fall.

FLEA BEETLES

Flea beetles attack young cabbages, radishes, and turnips. They are usually striped or greenish or bluish black. They are a little larger than fleas and have the same jumping habit.

Treatment.—See flea beetles, page 6.

See the warning regarding poisonous residues on page 41.

CELERY

LEAF BLIGHT

Leaf blight is a common name applied to any spotting of the leaves of celery. Three forms are fairly common and in some cases quite destructive to the crop, causing serious injury or defoliation of the plants and often resulting in shriveling or decay of the stalks after the plants are banked or put in storage. Two forms, the early blight and late blight, are due to fungi, and the third is caused by bacteria. Early blight is illustrated in figure 27.



FIGURE 27.—Celery early blight.

effective control, while in Florida 10 to 15 sprayings are often necessary. Very thorough spraying with high pressure to cover all parts of the foliage is essential.

Prevention.—Crop rotation is an important means of reducing the damage from leaf blight.

CELERY LEAF TIER

The celery leaf tier is a caterpillar about half an inch long, pale green or whitish in color. It is the young of a yellowish-brown moth about three fourths of an inch in spread (fig. 28). It is notable for its habit of webbing together the leaves of celery and related plants. The larvae also often feed down into the heart of the celery, injuring the stalks by cutting deep grooves in them and rendering them unfit for consumption.

The small whitish eggs are laid on the underside of the celery leaves, where they may be seen with the naked eye.

Treatment.—Dust with a mixture composed of equal parts of pyrethrum powder and sulphur or hydrated lime. Watch for the first

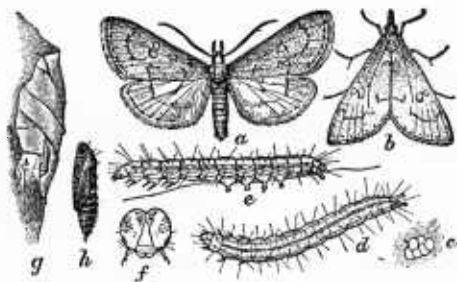


FIGURE 28.—The celery leaf tier: *a*, Moth; *b*, same in natural position at rest; *c*, egg mass; *d*, larva from above; *e*, same from side; *f*, head of same; *g*, pupa case; *h*, chrysalis. *a*, *b*, *d*, *e*, *g*, *h*, One half larger than natural size; *c*, twice natural size; *f*, more enlarged. (Chittenden.)

appearance of the larvae and blow the mixture well down into the crowns of the plants. Repeat the application in half an hour to kill the larvae forced from their protecting webs by the first application. One or two treatments are usually sufficient. Celery treated in this manner is nonpoisonous to the consumer, as the poisonous volatile oil of the pyrethrum is soon dissipated. For further information write to the Bureau of Entomology, United States Department of Agriculture.

CELERY CATERPILLAR

Celery and related plants are often attacked by a curious caterpillar, which when mature is about $1\frac{1}{2}$ inches long and green in color, ringed closely with black. It has the strange habit of protruding two yellow filaments from near the head when disturbed. This pest is the young of the handsome black swallowtail butterfly, spotted with yellow, so often observed about celery, parsnips, parsley, and carrots.

Treatment.—This pest is rarely sufficiently abundant to cause serious injury. If necessary, it may be controlled with calcium-arsenate spray on all crops except celery and parsley.

CUCUMBERS, MUSKMELONS, AND SQUASHES

WILT

Cucumber, muskmelon, and squash plants when attacked by the wilt disease usually wilt, dry up, and die very quickly (fig. 29). This is usually the first disease to appear in spring, often killing plants when 6 to 8 inches tall, and may continue to cause injury throughout the season. It is caused by bacteria which enter and multiply in the water vessels, thus cutting off the water supply and injuring the plants. Cucumbers are most susceptible to wilt and squashes least affected.

Treatment.—Pulling and burying or burning wilted vines during the early part of the season will assist in controlling wilt. Since striped cucumber beetles are the principal if not the only means of wilt spread, it is important that they be controlled by using the method given on page 24, enclosing the plants in insect-proof cages early in the season, followed by spraying with 4-4-50 bordeaux mixture and calcium arsenate.

MOSAIC

Cucumber, muskmelon, and squash plants attacked by the mosaic or white-pickle disease are stunted and have wrinkled or mottled

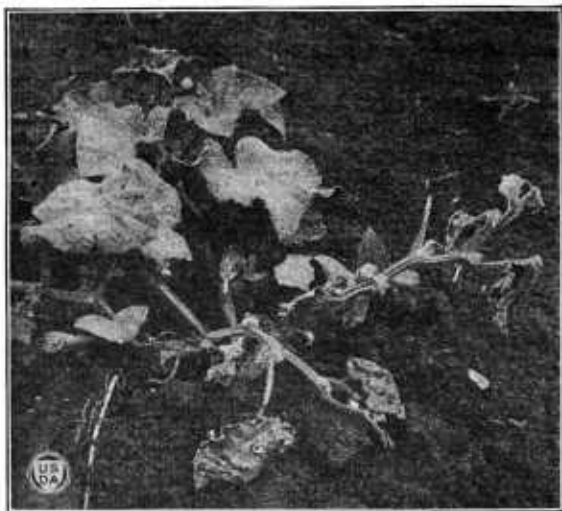


FIGURE 29.—Cucumber plant attacked by bacterial wilt.

yellow and green leaves. The yield of fruits is frequently very much reduced. The affected cucurbit and squash fruits are often crooked and covered with green warts (fig. 30), or they may be nearly white, and when badly diseased they are not good to eat. Many affected muskmelons remain small and are not edible. The disease also attacks wild cucumbers, the common milkweed, pokeweed, and ground cherry, and possibly other wild and cultivated hosts, and lives over winter in their seed or roots. Mosaic is carried from these wild hosts to the cultivated vine crops in the spring by the striped cucumber beetles and other insects, and by them and also by pickers is spread from plant to plant in the garden.

Treatment.—The plants should be protected as long as possible with cheesecloth-covered cages to keep off the striped cucumber beetles (see p. 24 for details of beetle-control methods) and later sprayed or dusted as necessary to control lice and beetles.

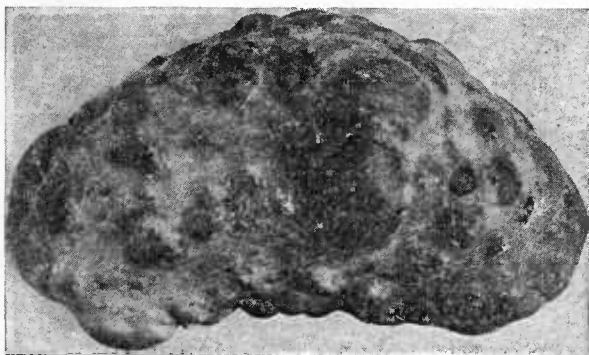


FIGURE 30.—Warty cucumber affected with the mosaic.

Prevention.—Remove all milkweed, pokeweed, wild cucumber, ground cherry, and other wild host plants in or near the garden to prevent insofar as possible the overwintering of the disease.

ANTHRACNOSE

Anthracnose is a fungous disease that attacks cucumbers

and melons particularly, causing roundish brown spots one fourth to one half inch in diameter on the leaves (fig. 31) and sunken elongated cankers on the stems, often killing both crops prematurely and either preventing the growth of the melons or seriously injuring their quality and causing a ripe rot of cucumbers and melons. Green melons are also sometimes attacked and round to irregular sunken spots with pink centers produced. The trouble occurs in the latter part of the season and if warm, moist weather prevails may kill the vines in 2 or 3 weeks.

Treatment.—Timely and thorough spraying with 4-4-50 bordeaux mixture (p. 39), will hold the disease in check. Begin to spray as soon as the very first signs of disease are seen or soon after the vines begin to run, and continue the spraying at weekly intervals.

Prevention.—Since the disease lives over winter in the soil and probably also on the seed, preventive treatment is very important. Rotate so that vine crops will not follow vine crops, and disinfect the seed with mercuric chloride before planting it (p. 40).

DOWNY MILDEW

Like anthracnose, downy mildew, also a fungous disease, causes spots on the leaves of most cucurbits, which soon curl, dry up, and

die. The spots are smaller than anthracnose spots, however, and are yellowish above and purplish underneath. When warm, moist weather occurs this disease kills the plants more quickly than anthracnose. No conspicuous fruit spotting is caused, but the early death of the foliage results in immature, insipid fruits. Downy mildew occurs most frequently and severely in the Atlantic Coast and Southern States.

Treatment.—Spraying as for anthracnose will keep the plants alive 2 to 3 weeks longer than unsprayed plants live.

Prevention.—Rotate crops.

ANGULAR LEAF SPOT

Angular leaf spot, caused by bacteria, attacks particularly the leaves of cucumbers, causing angular spots one sixteenth to one eighth of an inch across. At first the spots are water-soaked; later they dry and whiten and often drop out. The cotyledons are

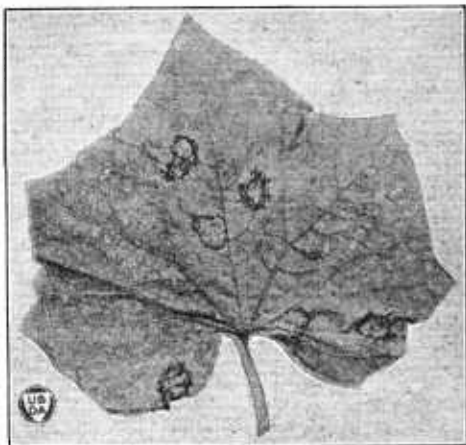


FIGURE 31.—Cucumber leaf showing anthracnose spots.

first attacked, as the disease is seed-borne. During continued wet weather in midseason considerable damage may be caused.

Treatment.—Angular leaf spot can be readily controlled by spraying as for anthracnose, but preventive treatment is much simpler.

Prevention.—Disinfecting the seed with mercuric chloride before planting it is the simplest and most effective form of control when combined with crop rotation (p. 40).

LEAF SPOT

Leaf spot is a fungous trouble that is most serious on muskmelons,

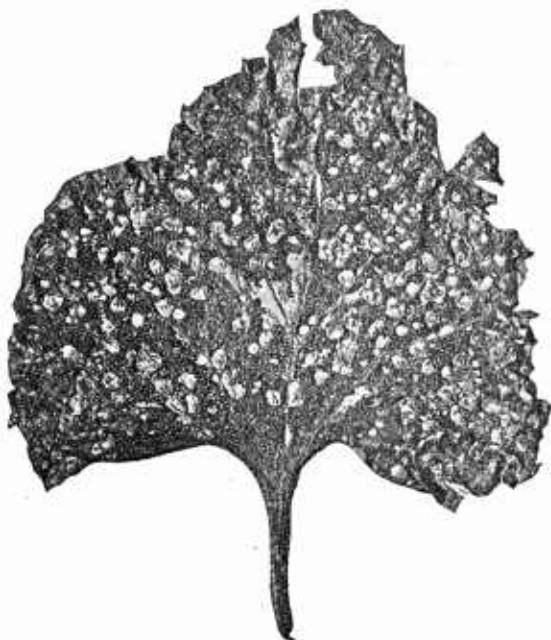


FIGURE 32.—Muskmelon leaf spot.

but it also attacks cucumbers, particularly in the Western States. The leaves show small irregular, brown, dead spots, and on musk-

melons the leaves soon curl up and die (fig. 32). On cucumber leaves it causes dead areas that soon fall out, leaving ragged holes and edges.

Treatment.—Spray with 4-4-50 bordeaux mixture, as for anthracnose (p. 22).

Prevention.—Rotate crops, and where possible use resistant varieties.

STRIPED CUCUMBER BEETLE

The striped cucumber beetle (fig. 33), as well as the 12-spotted cucumber beetle, lives throughout the Eastern States. In other

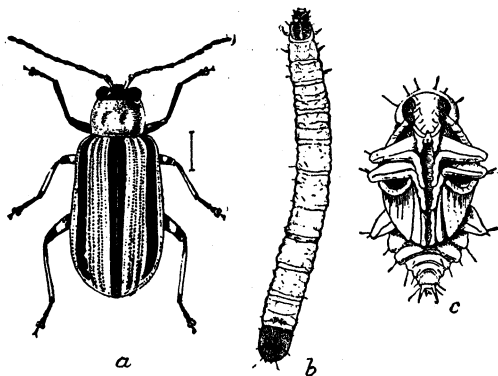


FIGURE 33.—Striped cucumber beetle: a, Beetle; b, rootworm; c, pupa. Small line at the right of the beetle is its natural length. (Chittenden.)

States there are several other kinds of beetles that have about the same habits and can be treated in the same way. The common form in the East, the striped cucumber beetle, sometimes called the striped bug, melon bug, or "cukey bug", is about one fourth inch long and yellow, and has three black stripes. The worm, or larva, is slender and white with brownish ends. Injury is done mainly by those beetles which live through the winter and eat the young plants in the spring.

The beetles also injure older plants by eating the leaves and gnawing the stems and roots. They usually come out in April or May. Late in the season they gather around the stems and leaves of cucumbers, but on the first cool nights in the fall they seek shelter. In the larval

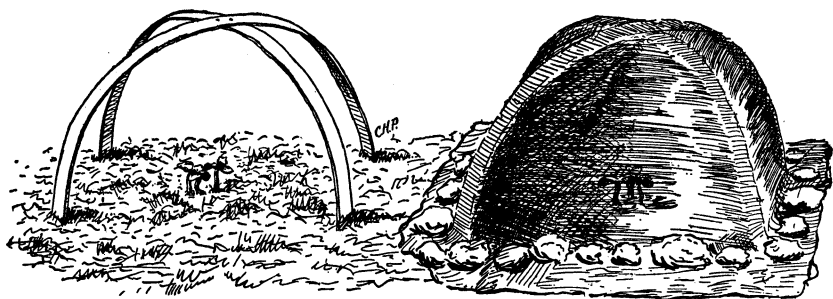


FIGURE 34.—Barrel-hoop and cheesecloth cover for cucumber and squash plants to keep away insects.

stage this insect causes damage to the roots. The beetles also spread diseases of cucumbers, squash, and melons.

Treatment.—The simplest protection from this and other beetles is to cover each young plant with a frame made by placing the halves of a barrel hoop in the position shown in figure 34 and covering the frame thus made with cheesecloth. Good cheesecloth must be used.

The beetles easily go through mosquito netting, and anything heavier than cheesecloth keeps the light from the plants. The lower edges of the cloth must be held down to the ground tightly by stones or other weights or the beetles will burrow underneath. Rectangular cheesecloth-covered frames of any size and shape desired can also be made with inch-square corner pieces, to which strips of lath are nailed.

Applying nicotine dust to the beetles gathered on the plants, taking care that it comes in contact with the insects themselves, is also very satisfactory. A mixture of 1 pound of calcium arsenate with 15 pounds of gypsum or land plaster is also useful. Bordeaux mixture with calcium arsenate added drives away the beetles and prevents injury to the leaves so treated.

See the warning regarding poisonous residues on page 41.

TWELVE-SPOTTED CUCUMBER BEETLE

The 12-spotted cucumber beetle (fig. 35), which is a little larger than the striped cucumber beetle, often eats cucumber leaves, causing much injury. The larva lives mainly on grass and corn roots.

Treatment.—The protective measures used for the striped cucumber beetle are the best remedies.

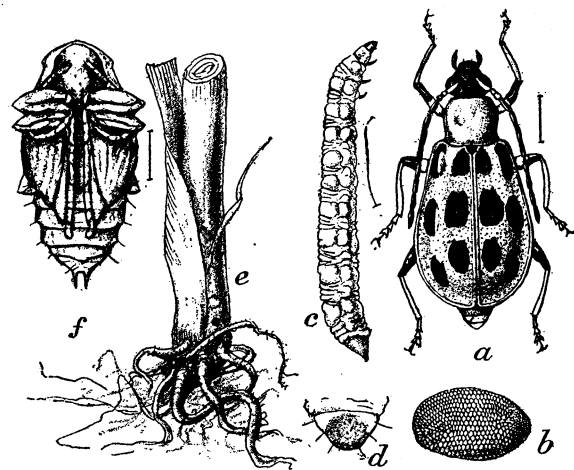


FIGURE 35.—Twelve-spotted cucumber beetle: a, Beetle; b, egg; c, rootworm; d, anal segment of larva; e, work of rootworm on corn root; f, pupa. The small lines at the right show the natural size. (Chittenden.)

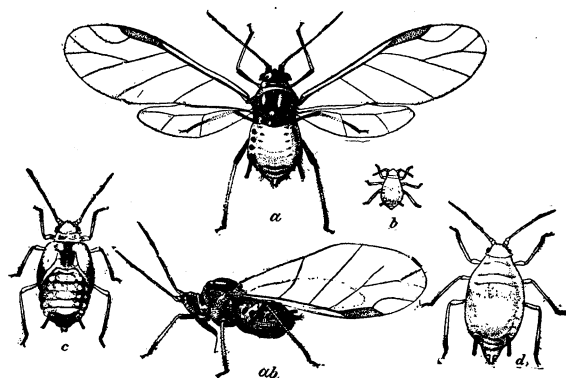


FIGURE 36.—The melon aphid or louse: a and ab, Winged aphids; b, new-born young; c, nymph stage; d, wingless female. Much enlarged. (Chittenden.)

MELON APHID

The melon aphid (fig. 36), commonly called the melon louse, is very small and greenish or nearly black. It sucks the juices of cucumbers and many other plants. It occurs from early spring and summer till late autumn and early winter. In seasons that favor its increase, it often appears in great numbers and does much damage, gathering in masses

on the undersides of the leaves, causing them to curl, shrivel, and lose color, and stopping the growth of the fruit. It often kills the plants outright. An attacked melon plant is shown in figure 37. The melon aphid gives off honeydew, a honeylike juice. When the aphids become very thick the honeydew covers the leaves with a thin sticky coating to which the white skins of the aphids adhere, and this attracts attention to the injury, as do also the wilting and dying of the plants.

Treatment.—The best remedy is dusting with nicotine dust. Spraying with nicotine sulphate is also helpful.

COMMON SQUASH BUG

Squashes, gourds, and pumpkins suffer from the same pests as cucumbers. They may also be damaged by the squash bug (fig. 38), commonly known as the stink-bug on account of its disagreeable odor. It feeds on the plant juices.

Treatment.—Pick off the insects by hand before they lay their eggs. The shiny brown eggs are easily seen on the underside of the leaf and can be crushed. The full-grown bugs are hard to kill but may be trapped by placing small pieces of board, shingle, or bark on the ground near the plants. The insects will hide under these pieces of



FIGURE 37.—Melon leaves curled by the melon aphid. (Chittenden.)

wood during the day. The traps should be examined each morning and the bugs killed.

SQUASH BORER

After cucumbers and melons have made good growth they are sometimes attacked by the squash borer, or squash-vine borer (fig. 39), which, however, is much more destructive to pumpkins and squashes, especially the Hubbard and summer bush squashes. This is the large white grub that bores through the stems, sometimes cutting them almost through near the roots.

Treatment.—When the borers attack cucumbers it is almost impossible to kill them without killing the plants. The borers may be cut out of squash vines by slitting the stems of the vines lengthwise.

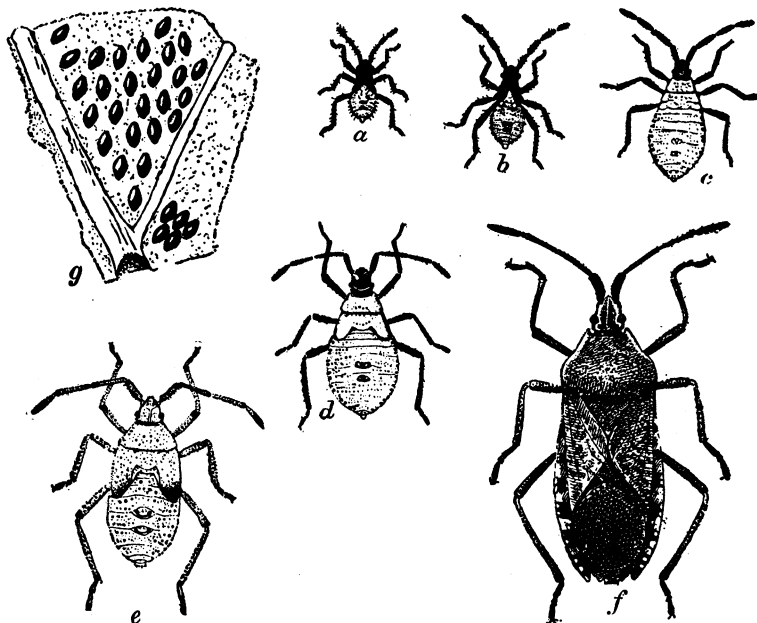


FIGURE 38.—Common squash bug: *a, b, c, d, e*, Partly grown young; *f*, full-grown bug; *g*, eggs. Enlarged. (Chittenden.)

Afterward, those portions of the vines should be covered with earth to help the plant grow extra roots. Keep the plants growing vigorously and free from other insects and diseases. It is reported that

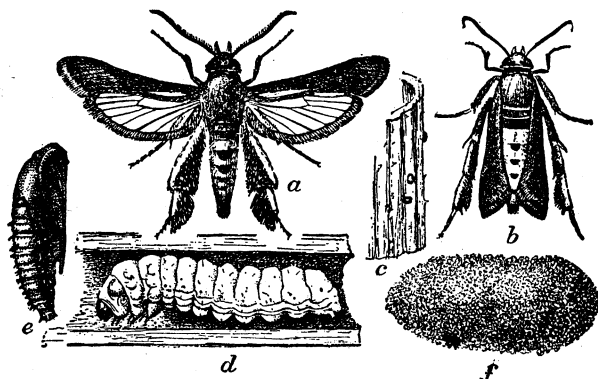


FIGURE 39.—Squash borer: *a*, Moth with wings spread; *b*, moth at rest; *c*, egg on section of vine; *d*, caterpillar or grub in squash vine; *e*, chrysalis; *f*, chrysalis cell from ground. Enlarged one third. (Chittenden.)

nicotine sulphate, 1 part in 100 parts of water, applied to the basal part of the vines, will reduce infestation. Four or more applications at weekly intervals, beginning in late June or early July, may be required.

Prevention.—The dead vines and old plants should be destroyed as soon as the crop is gathered. Harrow the garden lightly in the fall and plow deeply in the spring to keep the moths from coming out.

ONIONS

SMUT

The most common and serious disease of onions is smut, which is caused by a fungus which lives in the soil where smutted onions have grown. It produces blisters full of black powder on the leaves of young plants (fig. 40), killing them and reducing the yield.



FIGURE 40.—Onion smut. A young plant showing blisters which later break and expose black powdery spore masses.

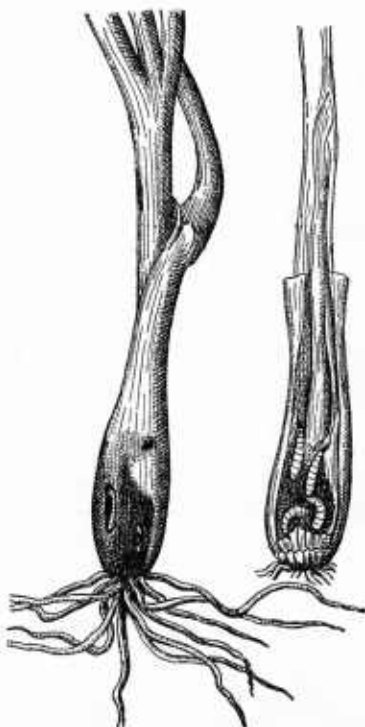


FIGURE 41.—Young onion plant, showing onion maggots at work in the bulb: at the right, plant exposed slightly, showing the same. (Chittenden.)

Prevention.—If possible plant onions on land where the disease has not occurred. If this cannot be done, sprinkle formaldehyde solution (1 teaspoonful to 1 quart of water) in the drill after the seeds have been dropped, before covering them, using 3 to 4 quarts of the solution to each 100 feet of row.⁶

ONION THRIPS

The onion thrips is a very small whitish or brownish insect, often incorrectly called onion louse, which by feeding in large numbers on

⁶ For further details as to prevention see Farmers' Bulletin 1030, which may be purchased for 5 cents from the Superintendent of Documents, Government Printing Office, Washington, D.C.

the leaves causes injury known as white blast, white blight, or silver-top. The insect often completely destroys large fields of onions. It also attacks cauliflower, cabbage, cucumbers, melons, pumpkins, squashes, parsley, tomatoes, kale, turnips, and seed beets, feeding on the undersides of the leaves, which become covered with fine white spots, showing where the insect has withdrawn the sap of the leaf for food.

Treatment.—Nicotine sulphate is used with success.

ONION MAGGOT

The onion maggot (fig. 41) is the worst northern onion pest. It eats into the bulb, starting decay, and often destroys the whole onion. The onion maggot is the larva of a small gray fly which looks like a small house fly. Two or three broods may be looked for each year, and the first flies usually appear about apple-blossom time.

Treatment.—Use bichloride of mercury prepared as recommended for the cabbage maggot and pour along the rows. When seed is sown, begin the treatment when plants are an inch high; if sets are planted, when they begin to sprout. Repeat at 10-day intervals, making from 5 to 7 applications. After the maggots enter the bulbs treatment is useless. A lubricating-oil emulsion made by pouring 1 gallon of bordeaux mixture into 1 gallon of light lubricating oil, pumping the mixture back upon itself until a good emulsion is secured, and diluting this with 40 gallons of water, is also useful in large plantings. Cover the plants and the soil around them thoroughly with this emulsion, and repeat the treatments 3 or 4 times, at weekly intervals.

PEAS

POD SPOT

Dark spots sometimes appear on the pods of peas (fig. 42). This trouble, called pod spot, is caused by a fungus which also produces spots on the leaves and on the seeds, in which it is carried from one season to the next.

Treatment.—There is no effective treatment for a diseased crop.

Prevention.—Since the fungus also lives over winter on diseased vines, a long crop rotation is necessary, together with the planting of seed saved from healthy pods and showing no spots.

STEM AND ROOT ROT

Peas affected by stem and root rot do not grow vigorously, often turn yellow, and sometimes die at flowering time. The stem below ground and the roots will be found decayed and yellowish brown or black in color. The yield of peas is often seriously reduced. Several fungi which live in the soil are responsible for this trouble.

Treatment.—No treatment is effective for diseased crops.

Prevention.—Rotation of crops, allowing three or more years between pea crops, is the best-known method of control.



FIGURE 42.—Pea pod spot.

PEA APHID

The pea aphid, one of the largest of the plant lice, is about one eighth of an inch long and pea green. The aphids gather in clusters about the tips of the young vine. Later they attack the stem and pods, sapping the life of the plant.

This aphid also feeds on clover, alfalfa, field peas, and several weeds.

Treatment.—Nicotine sulphate as a dust or spray is a good remedy if used when the insects first begin to attack the plants in early spring. The aphids can also be beaten from the vines onto the ground by means of a brush of small twigs or a pine bough with the leaves left on. On a warm, sunny day they are killed by the heat of the ground, and few, if any, ever return to the plants.

PEA WEEVIL

Seed peas often have a single round hole in each made by a pea weevil or pea "bug." This insect is about one fourth inch long and is thickly covered with brownish scales with black and white markings. Often every pea in a pod is infested with a weevil. In dry seed the chamber under the skin, in which the insect lives, can be seen plainly. Many seeds that have been attacked will start to grow, but the plants are likely to be weak. Since this weevil has only one brood a year it is treated more easily than is the bean or the cowpea weevil.

Prevention.—If you raise your own seed, keep it in a warm room in a tight bag or box for one full season before planting it. The weevils will come out of the seed so kept and die. Do not plant seeds that have been injured by weevils.

FOUR-SPOTTED BEAN WEEVIL AND COWPEA WEEVIL

The 4-spotted bean weevil and the cowpea weevil are similar in appearance and habits. They prefer cowpeas as food, but in the South they also attack table beans, chickpeas, and peas; in fact, all such seeds sufficiently large to sustain a single larva. They differ from the true pea weevil in that they are capable of producing several broods each season in dry seeds.

Treatment.—Fumigate with carbon disulphide, or, if the seeds are not to be used for planting, place in a shallow pan and bake in an oven for 5 to 10 minutes.

POTATOES

SCAB

Common scab (fig. 43) appears as rough-pitted spots on the potato tubers and is due to a soil fungus. Severely attacked potatoes are covered with scabs, which make an unsightly product and cause waste in paring. The disease lives in the soil and is also carried on the tubers.

Treatment.—The control of scab is entirely preventive.

Prevention.—If possible, plant on land known to be free from scab infestation. Do not use lime, fresh stable manure or wood ashes

for fertilizer on infested land where potatoes are to be planted. Flowers of sulphur or finely ground sulphur broadcast, one half to 1 pound per 100 square feet, has given control on some soils, though it may cause injury to certain other crops in the rotation, especially crucifers. Do not plant badly scabbed seed, and treat all seed potatoes, just before cutting, in formaldehyde or mercuric-chloride solution (p. 40).

LATE BLIGHT

In years when cool, moist weather occurs during late July and August, late blight often causes great losses, particularly in the Northern States. The disease attacks the leaves and stems, causing irregular dead areas (fig. 44), killing the plants prematurely, and reducing the yield. In moist, cool weather the disease spreads very fast, killing the plants in a few days. Later, it produces a brown rotting of the tubers (fig. 45), which continues in storage.

Treatment.—Late blight can be controlled by carefully spraying the plants with 4-4-50 bordeaux mixture, beginning when the disease



FIGURE 43.—Potato scab; tuber unfit for planting.

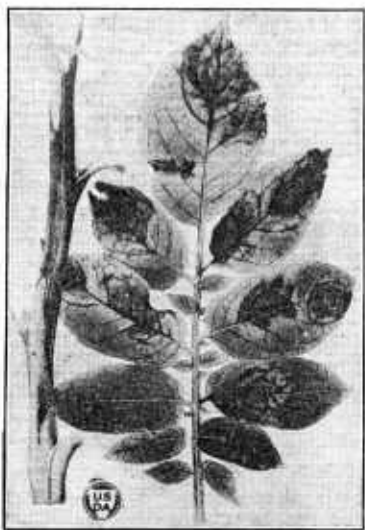


FIGURE 44.—Potato leaves and stem, showing injury by late blight.

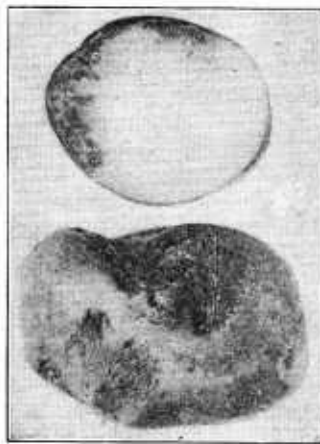


FIGURE 45.—Potato tubers affected with late blight rot.

is first seen. Repeat the spraying every 10 to 14 days in dry weather and every 7 to 10 days in moist weather.

Great care and thoroughness must be used to keep the foliage covered at all times with a thin film of the spray mixture. Potatoes showing rot at digging time should not be stored with the sound ones.

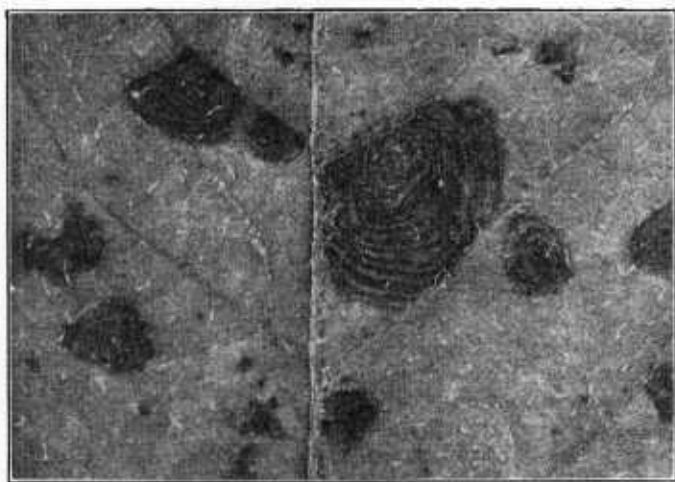


FIGURE 46.—Early blight spots on potato leaf (considerably enlarged to show target-board markings).

Prevention.—Select tubers free from late-blight rot for planting, since the disease lives over winter in the diseased potatoes.

EARLY BLIGHT

Early blight is a fungous trouble that usually appears in early July in the Northern States, causing on the leaves dark roundish to irregular spots with characteristic target-board markings (fig. 46). Moist warm weather is most favorable for its development.

Treatment.—Spray as for late-blight control.

WILT AND DRY ROT

The wilt, due to fungi in the water vessels, is marked by a yellowing and drooping of the foliage in hot weather and slow wilting of the plants, resulting in reduced yields. The interior of the stems and tubers shows a brown ring (fig. 47), and subsequently the tubers may dryrot in storage. The disease is carried in the affected tubers, which are thus made unfit for food or seed.

Treatment.—No treatment can save affected plants.

Prevention.—Seed potatoes showing any internal discolorations should be discarded. Use only the best disease-free seed. A long rotation helps to reduce the disease in the soil. Where the disease is very prevalent, the use of whole small tubers is preferable to

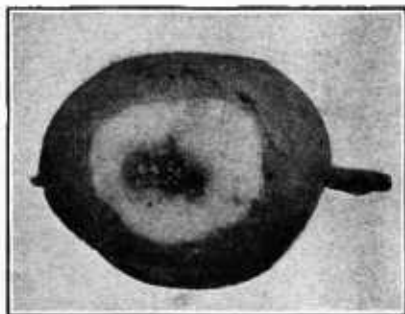


FIGURE 47.—Potato stem-end browning due to wilt.

cut seed, provided they are known not to have come from weak or diseased plants.

MOSAIC AND LEAF ROLL

Mosaic and leaf roll belong to a group of so-called "virus diseases" which are known to be carried in the tubers from diseased plants and to be spread by insects, even though their exact cause has not yet been discovered. They are the most serious potato diseases, by reason of the marked reduction in yield which they cause and also on account of the difficulty of securing healthy seed, which are essential to the production of a healthy crop.

Mosaic is characterized by light and dark-green mottling of the leaves, often accompanied by crinkling and dwarfing (fig. 48) and in severe cases by pronounced stunting of the plants.

Leaf roll is recognized by the yellowing and dwarfing of the plants and the upward rolling of the lower leaves, whose texture is leathery to the touch (fig. 49).

Treatment.—The control of plant lice will delay the spread of these diseases.

Prevention.—The use of seed free from disease is the only known control measure. Many of the Northern States have a potato-inspection and seed-certification service, and growers whose fields, as shown by one or more inspections, are sufficiently disease-free are given a certificate and are allowed to sell their crop as "certified seed." This certified seed is usually

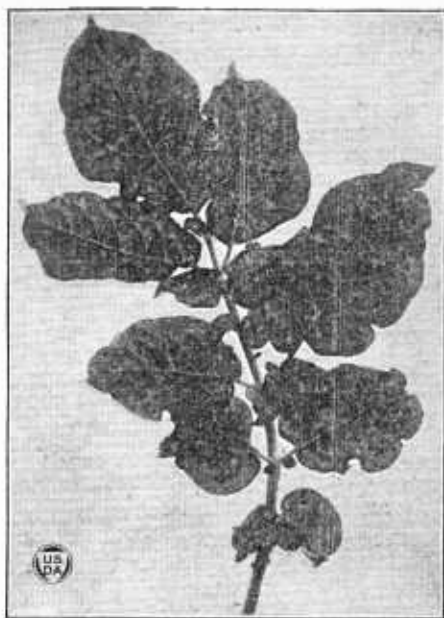


FIGURE 48.—Potato mosaic on leaf.



FIGURE 49.—Potato leaf roll.

better than ordinary seed, giving larger yields of healthier tubers.

COLORADO POTATO BEETLE

Both larvae and adults of the Colorado potato beetle (fig. 50) feed on the potato plants. After passing the winter in the ground, the beetles appear about the time the potatoes come up, lay their eggs on the undersides of the leaves, and begin feeding. They often destroy small patches in the garden. The beetles sometimes feed also on eggplants and tomatoes. There are from one to three broods a year.

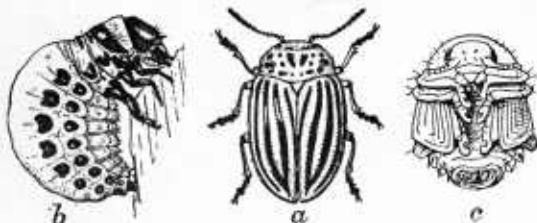


FIGURE 50.—Colorado potato beetle: a, Beetle; b, larva or "slug"; c, pupa. (Chittenden.)

Treatment.—Paris green is the best remedy. Hand-pick the beetles when they first appear.

BLISTER BEETLES

Blister beetles, which rank next to the Colorado potato beetle as potato pests, have been described on page 5.

FLEA BEETLES

Small round holes in the leaves of potato and various related crops, such as tomato and eggplant, show the presence of flea beetles. (See also p. 6.)

Treatment.—Calcium arsenate put on as a spray is the best remedy, especially if stirred into bordeaux mixture. Bordeaux mixture alone is an excellent spray to drive the beetles away. Spray both sides of the leaves. A dust of 1 part of calcium arsenate to 8 parts of hydrated lime, applied to both sides of the leaves with a good duster, may be effectively used. The spraying or dusting should be repeated twice at intervals of 10 days.

See the warning regarding poisonous residues on page 41.

SWEETPOTATOES

STEM ROT

Stem rot occurs nearly everywhere sweetpotatoes are grown. It is due to a fungus which enters and grows in the water vessels, causing a yellowing and wilting of the plants and reduction in the yield. Stems from such plants are black inside, and the sweetpotatoes show a black ring (fig. 51), and if such roots are used for bedding next season they will produce diseased plants.

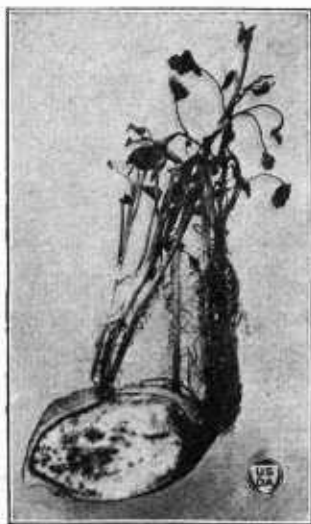


FIGURE 51.—Section showing stem rot in sweetpotato and in sprouts.

Prevention.—The home gardener in buying sweetpotato plants should make sure that they are sound and healthy, with clean, white roots and stems, and should plant them on land not in sweetpotatoes the year previous. Those who grow plants for large fields should secure Farmers' Bulletin 1059,⁷ which gives directions for growing healthy plants.

BLACK ROT

Black rot is a widespread fungous disease causing roundish, black, sunken spots of varying size on the sweetpotatoes and black cankers on the stems or underground parts (fig. 52). The disease is carried in the roots and readily attacks the slips. Black rot spreads freely in storage, and affected sweetpotatoes have a bitter taste when cooked.

Prevention.—The same as for stem rot.

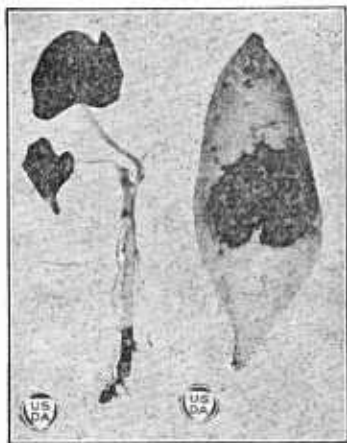


FIGURE 52.—Sweetpotato and slip, showing black rot.

SWEETPOTATO WEEVIL

In some parts of the Gulf States sweetpotatoes are often attacked by a small antlike beetle with a bluish-green head and abdomen and red legs and thorax (fig. 53). This pest is about one fourth inch long and comes from a whitish larva, or grub, slightly larger in size, which by tunneling through sweetpotato tubers renders them unfit for food. Several broods may be produced each year. Although this weevil works in the field it continues its injuries in the storehouse.

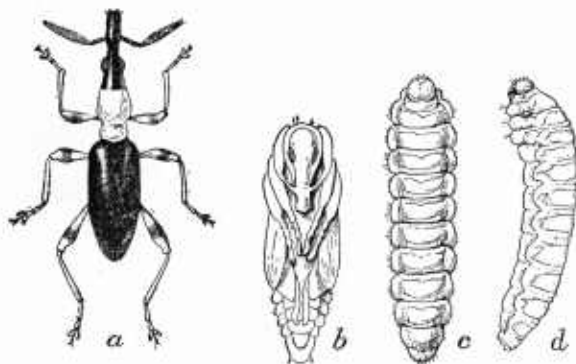


FIGURE 53.—The sweetpotato weevil: a, Beetle; b, pupa; c, larva, view of back; d, larva, side view. Much enlarged.

Prevention.—Carefully sort all sweetpotatoes, throwing aside or using immediately those showing the work of the weevil. Plant only uninfested tubers for the slip bed. Carefully clean out and burn all old vines and remnants from last year's field. Plant the new field as far from the old one as possible.

⁷ May be purchased for 5 cents from the Superintendent of Documents, Government Printing Office, Washington, D.C.

TORTOISE BEETLES

There are several kinds of small beetles (fig. 54), shaped much like turtles, which feed on sweet potatoes.

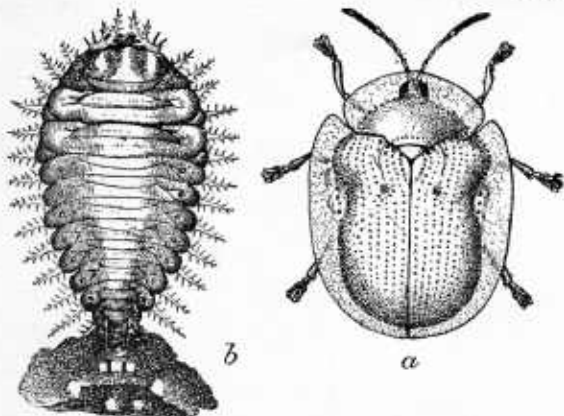


FIGURE 54.—The golden tortoise beetle: a, Beetle; b, young. Greatly enlarged. (Chittenden.)

Some are golden, marked with black. They and their young eat the leaves. The young are peculiar spiny grubs with long forked tails, which they carry over their backs, loaded with dirt for protection.

Treatment.—The grower need not spray for these pests unless they become serious. In that case use an arsenical.

See warning on poisonous nature of arsenicals, page 41.

TOMATOES

WILT

The widespread and serious tomato disease known as wilt is caused by a fungus that enters the roots from infested soil, grows into the water vessels, and produces an upward rolling of the leaves, followed by gradual yellowing, wilting, and death of affected plants (fig. 55). The fungus which causes the disease lives in the soil and is also carried in the seed.

Prevention.—Use wilt-free seed and wilt-free soil for growing plants, disinfecting the soil if necessary. If the home garden has become infested with wilt, plant only wilt-resistant varieties. Several excellent varieties of wilt-resistant tomatoes, namely, Norton, Nor-duke, Marvel, Columbia, Marglobe, and Pritchard, have been developed by the United States Department of Agriculture and are now listed by seedsmen. They produce large crops of fruit on soil where most other varieties are destroyed by wilt.



FIGURE 55.—Tomato wilt (late stage), showing dead leaves and stems and unfruitfulness.

LEAF SPOT

Leaf spot is caused by a fungus which attacks the leaves and stems, causing small circular spots with light centers and dark margins (fig. 56). It starts on the lower leaves and progresses upward, causing them to curl, dry up, and fall off, leaving the stems bare except at the tips. This defoliation results in a reduced yield and poor quality.

Treatment.—Spray thoroughly with bordeaux mixture (p. 39), beginning as soon as the plants are set out and repeat every 10 days.

Prevention.—Set only healthy plants. Rotate crops, and plow under old tomato vines in the fall.



FIGURE 56.—Tomato leaf spot.

BLOSSOM-END ROT

Blossom-end rot causes large, dark, sunken spots on the blossom end of the green fruits (fig. 57). Its cause is not well understood, but it appears to be connected with soil conditions, particularly with the water supply.

Treatment.—Watering the plants during very dry weather has been found helpful in controlling blossom-end rot. Frequent cultivation is also of assistance.

Prevention.—The plowing under of stable manure, green manure, or other vegetable matter will increase the water-holding power of the soil and thus reduce injury from blossom-end rot.

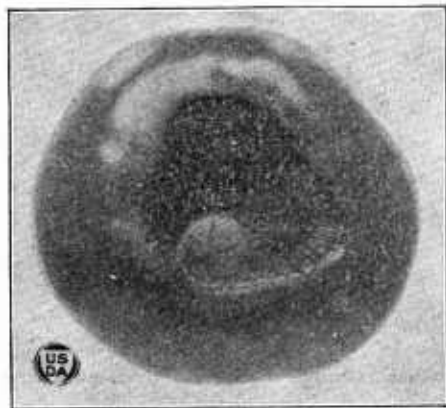


FIGURE 57.—Blossom-end rot of tomato.

TOMATO WORMS OR HORNWORMS

Certain large green caterpillars called tomato worms, tobacco hornworms, or tobacco worms feed on both tomato and tobacco plants. There are two different species, of very similar appearance, one of which is shown in figure 58. They are the young of large humming-bird moths. In spite of the wicked-looking horn on the tail, they are entirely harmless to persons. A large hornworm can strip a tomato plant in 2 or 3 nights, leaving

only the stems. There are two broods a season. The gardener should be on the lookout for the first as well as the second brood.

Treatment.—Hand picking is the best remedy. Sharp eyes are needed to see the worms when they are not moving, since they are the same color as the stems on which they rest during the day. They may often be discovered by their voidings. When feeding they are more readily seen and can easily be killed.

Enemies.—Tomato hornworms will often be found carrying many small white objects on their backs. These are not the eggs of the caterpillar, as many believe. The caterpillar is incapable of laying eggs. The

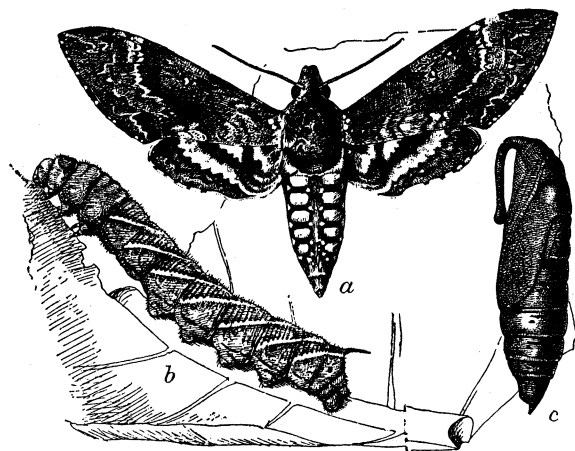


FIGURE 58.—Tomato hornworm: a, Moth; b, hornworm; c, chrysalis. About one half natural size. (Howard.)

white objects are the cases or cocoons from which come small parasitic insects that prey entirely upon the hornworms and are one of the most effective natural controls for these pests. Do not destroy the hornworms bearing these cocoons, as killing the parasites prevents the continuation of their good work, particularly since the caterpillars do no feeding after the parasites begin to come out.

TOMATO FRUITWORM

The tomato fruitworm, (fig. 59), also called the corn-ear worm, is the cause of much trouble to tomato growers, as it eats into the ripening fruit and destroys it.

Treatment.—Calcium arsenate or paris green applied 2 or 3 times will keep the insect partially under control. Applications may be made until the first fruits are about half grown.

See the warning regarding arsenical residues on page 41.

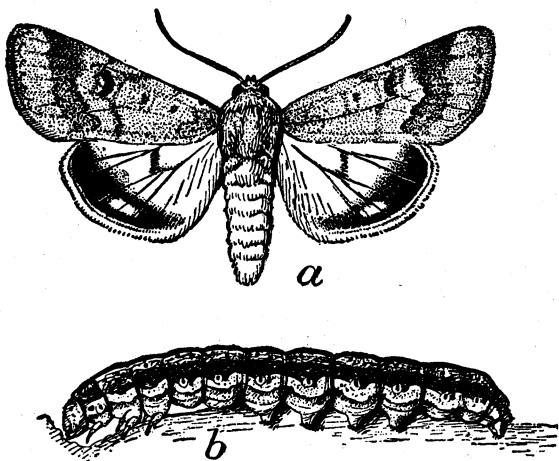


FIGURE 59.—Tomato fruitworm: a, Moth; b, full-grown fruitworm (Chittenden.)

FLEA BEETLES

The potato flea beetle frequently attacks tomatoes and does much damage.

Treatment.—Dip the young plants in a mixture made up of 3 ounces of calcium arsenate and 1 gallon of water before setting them out. Spraying the plants with bordeaux mixture will drive the beetles away.

FUNGICIDES AND INSECTICIDES

Fungicides are materials used to kill bacteria and fungi that cause plant diseases.

Insecticides are materials used to kill insects that attack plants.

FUNGICIDES

BORDEAUX MIXTURE

Bordeaux mixture is the best spray mixture for controlling leaf diseases of garden plants, the potato leafhopper on both beans and potatoes, and as a deterrent against flea-beetle attack. It is very important that gardeners realize that this mixture is a preventive and not a cure and that consequently it must be applied before or as soon as the very first signs of injury are seen. It can be purchased in convenient packages from seed dealers, or a better spray can be made more cheaply at home as follows:

Bluestone (copper sulphate)-----	4 pounds	} or {	4 ounces.
Quicklime (stone lime)-----	4 pounds		4 ounces.
or hydrated lime-----	6 pounds		6 ounces.
Water-----	50 gallons		3 gallons.

Dissolve the bluestone in a wooden or earthenware vessel, using hot water. Dilute with half the water. Slake the lime in a small quantity of water; then dilute with the rest of the water. Pour the diluted bluestone and lime solutions together, straining them through a fine cheesecloth or brass-wire strainer, and mix thoroughly. The mixture should be made fresh each time it is used, as it does not keep well.

Since stone lime air-slakes rapidly and is then no longer good for bordeaux mixture and also is often difficult to get at short notice, it is best to make up a stock solution of lime containing 1 pound to each gallon of water. This will keep indefinitely if not allowed to dry out. A stock solution of bluestone can also be made by dissolving 1 pound of the copper-sulphate crystals in a gallon of water. One quart of each of these stock solutions is equivalent to the 4 ounces of lime and bluestone given in the formula. The stock solutions may be stored in old glass jars or other containers until needed. Dilute each with half the required quantity of water before mixing. Where biting insects, such as potato beetles, are to be controlled, as well as diseases, add 2 ounces of powdered calcium arsenate to the above 3-gallon formula for bordeaux mixture.

Certain manufactured products, both pastes and powders, are available for making up bordeaux mixture and are especially convenient for use in small gardens and quite satisfactory under most conditions of moderate infection.

BORDEAUX DUSTS AND PASTES

Several bordeaux-dust mixtures are also on the market for the control of plant diseases. They have the advantage of being more quickly and easily applied than sprays, and they do away with the necessity

of carrying water needed for spraying. Under conditions of moderate infection fairly satisfactory results have been secured, but in severe outbreaks of diseases that progress rapidly more complete control has been obtained by thorough and timely spraying with home-made bordeaux mixture.

MERCURIC CHLORIDE

Mercuric chloride (corrosive sublimate) is commonly used for treating seed potatoes and cucumber and cabbage seed for disease control. It is most conveniently purchased at drug stores or agricultural supply houses in the form of tablets costing about 25 cents for 30. For the purposes for which its use is here advised, a 1 to 1,000 solution is used. This is made by dissolving two large tablets in a quart of water. For larger quantities use at the rate of 1 ounce to 8 gallons of water.

To free seed potatoes from scab and black scurf soak them for half an hour in the mercuric chloride solution. Treat cucumber seed for 5 minutes, stirring frequently, and then rinse thoroughly in running water, to control angular leaf spot and anthracnose.

Soak cabbage seed 30 minutes and then rinse in clean water.

While this substance is of particular value in treating seeds against disease, it is also applied against the root maggots that attack cabbages, radishes, and similar crops. The same proportions are used as for plant-disease treatment. Pour the mixture around the bases of the plants as soon as they are set out, or in the case of radishes and other row crops, along the rows with a watering can.

Since mercuric chloride is a deadly poison, great care must be taken to keep it out of the reach of children and farm animals, and no seed or tubers treated in it should be fed to any animals or human beings. Since mercuric chloride attacks metals, only wooden, glass, or earthenware vessels should be used in making the solution or treating the seed.

FORMALDEHYDE

Formaldehyde (formalin) is also used for treating seed potatoes, onion seeds, and soil to prevent diseases. It is a clear solution of 37-percent formaldehyde gas in water, which retails for about 35 cents a pint. It is very irritating to the eyes and to cuts and has a very drying effect on the skin, but is not poisonous. It does not attack metals. For most purposes use 1 teaspoonful to a pint, 1 ounce to 2 gallons, or 1 pint to 30 gallons of water. To protect potatoes against scab, soak the seed potatoes 2 hours in the above solution. To disinfect soil, drench the soil with a 1 to 200 solution at the rate of three fourths of a gallon per square foot of area several days before the soil is to be used.

INSECTICIDES

Two classes of insecticides are used for controlling insects—stomach poisons and contact poisons.

Stomach poisons, such as calcium arsenate, magnesium arsenate, and paris green, are used for insects like the striped cucumber beetles, bean beetles, and potato beetles, which injure plants by chewing the leaves or stems.

Contact poisons, such as pyrethrum, soap, and nicotine sulphate, that kill by touching the insects, are necessary for sucking insects like plant lice and squash bugs. Stomach poisons are of no value for sucking insects.

POISONOUS RESIDUES FROM SPRAYS

Sprays or dusts containing arsenicals or other poisonous chemicals of a stable nature, including the fluosilicates, should not be applied to the crop when foliage or fruits that will be marketed or eaten are on the plant, unless the residue can be removed by washing or stripping.

All of these poisonous materials should be applied as sparingly as is consistent with the control of the insect. In the case of dusting, every effort should be made to secure a light, even coating and to avoid excess application, such as frequently results from sprinkling the poison on the plant from a perforated can or sack. Early applications will frequently make it unnecessary to apply control measures late in the development of the plant.

ARSENICALS

Lead arsenate, since it contains two powerful poisons, lead and arsenic, is not recommended as a spray for vegetables and should never be used on those portions of garden vegetables intended to be eaten. Other arsenicals, such as paris green, calcium arsenate, and magnesium arsenate, are recommended instead. Two level teaspoonfuls of paris green or 6 of calcium arsenate to each gallon of water or other spray mixture will suffice for the preparation of small quantities for the home garden. The addition of three or four times as much lime will make these arsenicals safer from the standpoint of plant injury for use on most vegetable plants by taking up any free arsenic which might otherwise injure the foliage.

If these arsenicals are used as dusts they should be thoroughly mixed with from 5 to 10 times their volume of hydrated lime or gypsum.⁸

NICOTINE SULPHATE AS A SPRAY

For small gardens use a teaspoonful of nicotine sulphate⁸ in a gallon of water. A 1-inch cube of hard soap should be shaved up and thoroughly mixed with the solution. Full directions for mixing are given on the containers. For large aphids, like the pea aphid, a little more nicotine sulphate than stated above should be used. By looking carefully at the freshly sprayed plants, one can tell whether there is enough soap in the mixture. If the spray draws together in drops, more soap should be added. When possible fish-oil soap should be used, but cheap laundry soap will do. If the nicotine-sulphate solution has stood for any length of time, it should be mixed thoroughly before being used. The insects themselves must be wet by the spray, or they will not be killed. Therefore, the spraying should be very thorough and should be done as soon as the insects are noticed.

NICOTINE SULPHATE AS A DUST

Nicotine sulphate combined with a dry carrier is also useful whenever it is preferable to use this form of application; it is available commercially from several manufacturers. For home use it may be

⁸ A solution containing 40 percent of nicotine by weight.

prepared by adding the required proportion of nicotine sulphate to hydrated lime.

For the treatment of small plantings, 1 or 2 pounds of nicotine dust may be prepared by using an ordinary household flour sifter, using 1 pound of hydrated lime and 1 ounce of nicotine sulphate. Be sure that all lumps are broken up and passed through the sifter, and resift at least three times to insure a thorough mixture. Larger quantities may be prepared by placing the lime and nicotine in a keg or metal drum, together with several sizable stones or pebbles, and then rolling the drum for 4 or 5 minutes to secure thorough mixing. This mixture, prepared according to directions, is a satisfactory dust for use against plant lice and the striped cucumber beetle. For the latter, the ground around the plants, as well as the plants themselves, should be thoroughly whitened with the dust when the insects make their first appearance. A single application is usually successful, but the treatment may be repeated as often as required.

Nicotine dust must be preserved in tight metal or glass containers, as it loses its strength very rapidly when exposed to the air.

FLOWERS OF SULPHUR

Flowers of sulphur is used to apply broadcast on land that is infested with potato scab to increase the acidity of the soil and thus reduce the damage from scab. To control the red spider and some other kinds of mites, sulphur may be either dusted on plants or mixed with water, a teaspoonful of sulphur to a quart of water, and sprayed.

SOAP SPRAYS

Ordinary soapsuds is a good spray for plant lice and leaf hoppers. It should be made by dissolving a 1-inch cube of laundry soap or a rounded tablespoonful of whale-oil or fish-oil soap in a quart of hot water. This also must reach the bodies of the insects in order to kill them. This spray must not be used full strength on very tender plants, such as young cabbage or cauliflower in seed beds, on garden peas, or on young beans, as it will injure the leaves. Use half strength for these plants.

A stock solution of soft soap may be more convenient for quick or frequent applications, and may be made either from bar soap or soap flakes. The weight of actual soap contained should be taken into consideration in using such a mixture. The white coconut-oil soaps are particularly good as insecticides and will work well in hard water.

PYRETHRUM POWDERS AND EXTRACTS

The insect powders sold as buhach, Persian insect powder, and Dalmatian insect powder are composed of the finely pulverized flower heads of three species of *Chrysanthemum*. The active poison that they contain is a volatile oil that is much more poisonous to insects than to the higher animals. This oil forms the basis for a large number of commercial fly and household sprays and has recently been placed on the market as a contact insecticide for use against garden and greenhouse insects. It has the advantage of being practically nonpoisonous to human beings in the dilutions used against insects, and may safely be applied to such crops as greens, snap beans, cabbage, and celery. Either the pyrethrum powder itself or the

extracts made from it may be used. They should be kept in tight containers while stored, as they lose strength rapidly by exposure to the air. In applying them, they must actually touch the bodies of the insects against which they are used. Follow the directions of the manufacturer as to the application, as the concentration of the commercial preparations varies greatly.

ROTENONE INSECTICIDES

Materials (such as derris and cubé) containing rotenone as well as other substances with insecticidal properties are gaining prominence as insecticides. These materials may be obtained from many dealers, either in the form of dusts or as prepared sprays which require only dilution with water. These insecticides appear to be especially toxic to some caterpillars and will control some other insects effectively. The toxic elements are unstable when exposed to air and sunlight and consequently should not leave harmful residues. As the rotenone content varies greatly in the various dusts and sprays, they should be used according to the directions of the manufacturer.

HOW TO SPRAY

To be successful in the control of diseases and insects the spray mixtures must be properly made, and spraying must be done promptly and thoroughly. Do not wait until the plants have been seriously injured, but begin to spray as soon as the trouble is first seen. Use good apparatus and spray carefully. Using a watering pot or whisk broom is not spraying and is a hit-or-miss method that covers the plants only partially. The ideal spray is a fine mist, and the best work is done when the entire plant is thoroughly and evenly covered with very fine drops. Stop spraying before the foliage is drenched. The higher the pressure the better the spray.

Spraying with bordeaux mixture should be done before rains, rather than after, provided the spray has time to dry on the leaves. The intervals between spray applications should depend on the weather. If it is rainy or muggy, with fogs and heavy dews, these conditions are favorable for diseases, and spraying should be done more frequently to keep the foliage protected at all times. If the weather is dry, longer intervals may be allowed between sprays.

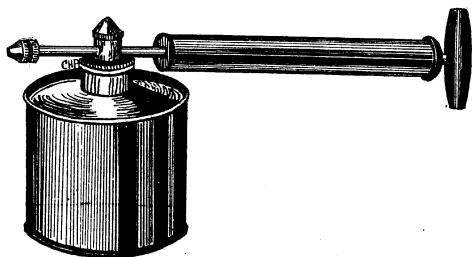


FIGURE 60.—An atomizer suitable for small gardens.

SPRAYING AND DUSTING TOOLS

The sprays and dusts described may be put on in many ways. For the small garden an atomizer sprayer (fig. 60) is good, but a compressed-air sprayer (fig. 61) is better for gardens of medium size.

The container for the liquid in the sprayers should be made of glass, brass, or galvanized steel, as bordeaux mixture and other materials corrode tin and iron.

Shaking the dusts from a fine cheesecloth bag or from a can with a handle and a perforated bottom are not recommended, as they frequently result in an uneven and excessive application of material.

Several small cheap but effective dust guns are on the market (fig. 62), and should be used in preference to the cruder methods.

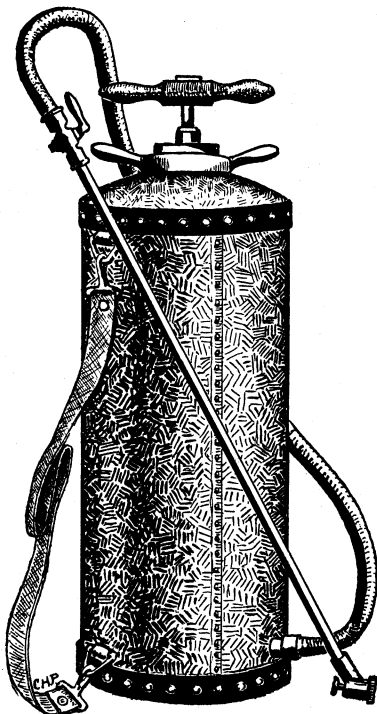


FIGURE 61.—A compressed-air sprayer suitable for larger gardens.

MISCELLANEOUS CONTROL METHODS

SOIL DISINFECTION

Young plants grown in flats or boxes, to be set in the garden, are often troubled with damping-off (p. 2) and young cabbage plants are likely to be attacked by clubroot (p. 13). The organisms that cause these diseases live in the soil and will be carried on the diseased plants into the garden. The best way to get rid of these organisms is to treat the soil a few days before planting the seeds, either with boiling water or formaldehyde solution or to steam it.

If the first method is used, set the flat or box of soil over the sink and pour the boiling water into it as fast as the soil will take it up. Use 9 quarts of water for a box 1 foot square with soil 4 inches deep. When the soil has dried out enough plant the seeds. In this treated soil seeds will

sprout better and plants grow faster and stronger than in untreated soil.

For directions for using formaldehyde solution see under Formaldehyde (p. 40).

The pressure cookers or steam sterilizers used for canning purposes are excellent for sterilizing small quantities of soil to kill insects and diseases or the soil may be thoroughly baked in a pan in the oven.



FIGURE 62.—A powder gun for applying dust mixtures in a small garden.

LIME

Lime is used in several forms in plant-disease control. Quicklime or stone lime in lump form, as commonly used for making plaster, is used for slaking to make bordeaux mixture. When it becomes air-slaked from long standing it is of no value for this purpose.

For applying to land to correct too great acidity air-slaked or hydrated lime is the best form to use. Ground limestone is also used. Its action is slower, and it may be applied in larger quantities without injury to the soil. For the control of cabbage clubroot apply hydrated lime at the rate of 25 pounds to the square rod. Do not apply lime to land to be planted in potatoes, since it will tend to increase scab injury.

Air-slaked lime will also keep away certain insects, and is a good remedy for slugs.

CARBON DISULPHIDE

Carbon disulphide is a clear yellowish liquid with a bad odor. It is used for treating seeds to kill weevils and other insects that breed in them. A tin bucket or can fitted with an airtight top makes a good fumigator. The seed should be placed in the bucket or can and the carbon disulphide poured on a piece of rag or waste cotton and dropped upon the seed. A teaspoonful of carbon disulphide is sufficient for a 1-gallon can or bucket. The lid should then be fitted on tightly and the can or bucket left for 24 hours. The seed should then be removed and aired.

Carbon disulphide is inflammable and its vapor is explosive. Keep it away from fire.

BENEFICIAL INSECTS

LADYBIRD BEETLES

There is a wide-spread belief that the small red ladybird beetles, shown together with the younger stages in figure 63, are the parents of injurious plant lice, on account of their abundant association with these pests during the growing season. This is not true, as the ladybird beetles are one of the most effective natural enemies of aphids. A well-grown or adult ladybird requires 50 to 80 plant lice for its daily meal. The beetles should therefore be encouraged as far as possible, as they are among the grower's best friends. They also eat the eggs of many injurious insects.

SYRPHUS FLIES

Other curious insects often associated with plant lice are green sluglike maggots, often marked with whitish stripes and about one half inch long. These are the young of small yellow black-banded flies (fig. 64) that may be found about "lousy" plants and are known as "syrphus flies." They should be protected, as they are among the most energetic enemies of plant lice.

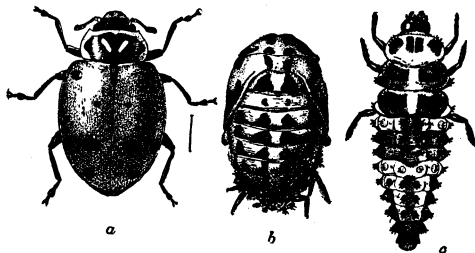


FIGURE 63.—A ladybird: a, Beetle; b, pupa; c, young. These beetles and their young eat dozens of plant lice each day. (Chittenden.)

Many other insects, among which are ground beetles, lace-wing flies, and tachina flies, are of benefit to the grower, who should learn to recognize them.

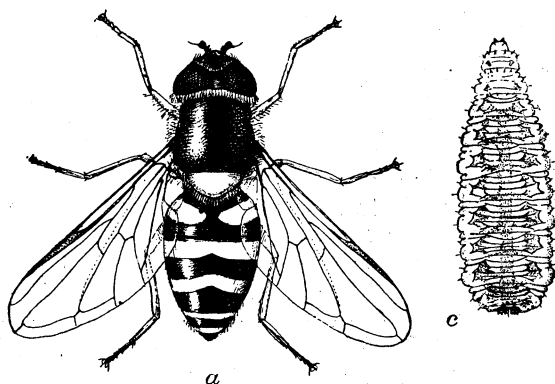


FIGURE 64.—A syrphus fly: *a*, Fly; *c*, maggot. This fly helps to control plant lice. It is about the size of a common house fly. (Chittenden.)

As a matter of fact, were not the efficiency of predacious insects so great, our crops would be a complete loss through attacks of plant-feeding insects, which would soon increase to such a point that no vegetables would be left.